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SIXTH INTERNATIONAL CONGRESS ON TUBERCULOSIS

IN SIX VOLUMES

VOLUME FOUR, PART TWO

PROCEEDINGS OF SECTION VII

Tuberculosis in Animals and Its Relations to Man

WASHINGTON, D. C.

SEPTEMBER 28 TO OCTOBER 5, 1908

Transactions

of the

Sixth International Congress on Tuberculosis.

WASHINGTON, SEPTEMBER 28 TO OCTOBER 5, 1908.

WITH AN ACCOUNT AND CATALOGUE OF THE TUBERCULOSIS EXHIBITION,

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In Six Volumes.

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Tuberculosis in Animals and Its Relations to Man.

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SECTION VII.

Tuberculosis in Animals and Its Relations to Man.

FIRST SESSION.

Tuesday Morning, September 29, 1908, in the New National Museum.

THE PREVALENCE AND ECONOMICS OF TUBERCULOSIS IN ANIMALS.

Section VII was called to order on Tuesday, September 29, 1908, by the President, Dr. Leonard Pearson. Honorary Presidents of Section VII were elected, as follows:

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Prof. Robert Ostertag, Berlin, Germany.

THE ECONOMIC IMPORTANCE OF TUBERCULOSIS OF FOOD-PRODUCING ANIMALS.

By A. D. Melvin, D.V.S.,

Chief of the United States Bureau of Animal Industry, Washington, D. C.

It is the purpose of this paper to call attention briefly to the serious injury which tuberculosis causes to the live-stock industry from the economic standpoint, and to suggest means of overcoming it, discussing the subject

as it affects the United States. Regardless of the question of the communicability of tuberculosis from animals to man and the bearing of animal tuberculosis on the public health, it is a well-known fact that this disease causes heavy financial loss to the live-stock industry; and while the saving of human life affords the highest motive for combating tuberculosis, the prevention of financial loss is alone a sufficient reason for undertaking the eradication of the disease from our farm animals.

The movement in the last few years for a more wholesome food-supply has resulted in drawing attention to the part played by tuberculosis as regards both health and economics. It must be realized that the exclusion of tuberculous meat and dairy products from the food-supply means a reduction in the quantity of available food, with a corresponding tendency to an increase in the cost of necessaries of life. The economic problem therefore concerns not only the stock-raiser and the producer, but the consumer, which means practically everybody. No nation is so wealthy that it can afford to sacrifice year after year a considerable and increasing proportion of its food-supply, especially when by proper means the loss can be reduced, and in time prevented entirely. This is a problem which must be faced eventually; and the earlier this is understood, the more easily it can be solved.

The Prevalence of Animal Tuberculosis.—While tuberculosis among animals is less prevalent in the United States than in some other countries, it has progressed to an alarming extent even in this country, and is undoubtedly on the increase, especially in States where no adequate measures have been taken against it. The animals principally affected are cattle and hogs. The disease readily spreads among cattle that come in close contact with each other, as in dairy herds, and experiments by the Bureau of Animal Industry have shown that it is easily communicated from cattle to hogs by the common practices of giving skim milk to hogs and allowing them to feed on the excrement of cattle. The increase of tuberculosis among hogs in the United States has been very marked in recent years. Sheep and goats are rarely affected, probably because of a natural tendency toward immunity, or because they are not generally exposed to infection.

The two principal sources of data as to the prevalence of tuberculosis among live-stock are (1) meat-inspection statistics and (2) records of the tuberculin test. Meat inspection throws light on the disease in cattle, hogs, sheep, and goats, while the information derived from the tuberculin test is practically confined to cattle.

Meat-inspection Statistics.—The Federal meat inspection, as extended under the law of June 30, 1906, now covers more than half of all the animals slaughtered for food in the United States, and the proportion of animals found affected with tuberculosis under this inspection service affords a basis

for forming some idea of the extent to which the disease exists among the meat animals of the country.

The following table shows the number of animals of each kind slaughtered under government inspection during the fiscal year ending June 30, 1908, and the number and percentage found affected with tuberculosis:

ANIMALS SLAUGHTERED UNDER FEDERAL INSPECTION IN THE UNITED STATES, WITH NUMBER AND PERCENTAGE FOUND TUBERCULOUS, DURING FISCAL YEAR 1908.

Kind	Number Slaughtered	Number Tuberculous	Percentage Tuberculous
Cattle	7,116,275	68,395	0.961
Calves	1,995,487	524	0.026
Hogs	35,113,077	719,309	2.049
Sheep	9,702,545	40	0.000
Goats	45,953	1	0.000
Total	53,973,337	788,269	1.460

Even a larger proportion of the animals slaughtered at establishments without Federal inspection are tuberculous, as one effect of a rigid inspection is to cause the establishments under inspection to exercise care in buying animals so as to minimize condemnations, while suspicious-looking animals are naturally diverted to the small local abattoirs that have no inspection. This was demonstrated by comparing results at establishments soon after they were placed under inspection by the new law with those at establishments where inspection had been in force for a long time, relatively twice as many cattle being condemned for tuberculosis at the former as at the latter places.

Taking these facts into consideration, it seems likely that more than 1 per cent. of the beef cattle in the United States are affected with tuberculosis to some degree, while over 2 per cent. of the hogs slaughtered are affected.

The Tuberculin Test.—It is known that dairy cattle are more generally affected than beef cattle, as the tuberculin test has shown that from 5 to 25 per cent. of the cows supplying milk to certain cities were tuberculous. For instance, tests made in 1907 on a large proportion of the herds supplying milk to the city of Washington showed about 17 per cent. of the cattle reacting.

For fifteen years the Bureau of Animal Industry has been preparing tuberculin and supplying it to State and city authorities for official use, besides using it in tests by its own employees. Recently the reports of tests

made with this tuberculin during this period have been carefully analyzed and tabulated. Out of 400,000 cattle tested, there were 37,000 reactions, or 9.25 per cent.

The majority of the cattle tested were dairy cattle, and the tests were made under various conditions. By far the larger proportion of the tests were made on cattle that had been within a State for a year or more. In some cases tests were made compulsorily on all cows supplying milk to a city; in other cases they were made when requested by owners, and in still others when the presence of tuberculosis was suspected in certain herds. It is impossible to determine accurately the weight of all these factors; but considering the fact that while dairy cattle largely predominate, their average is reduced by a certain proportion of other cattle, and offsetting against this the fact that the testing of herds under suspicion tends to raise the average somewhat, it seems reasonable to conclude from these tests that probably 10 per cent. of the dairy cattle in the country are affected with tuberculosis.

A remarkable feature of the reports referred to is the manner in which the diagnosis by the tuberculin test was confirmed by post-mortem examination on reacting animals that were slaughtered. Out of 24,784 reacting animals slaughtered, lesions of tuberculosis were found in 24,387—a percentage of 98.39. The Bureau has positive knowledge that in at least one State the testing was not done in a careful and reliable manner. If we discard the returns from this State, the proportion of cases in which the tuberculin reaction was confirmed by post-mortem is raised to 98.81 per cent. It is possible, too, that in some of the negative cases tuberculosis was really present, but the lesions were so slight as to escape detection on post-mortem examination by ordinary methods. Surely these figures, representing the work of scores of individuals in all parts of the United States over a period of fifteen years, bear strong testimony to the marvelous accuracy of the tuberculin test. Further evidence on this point is afforded by the slaughter, during the past year or two, in or near the city of Washington, of 126 cattle which had reacted to the test when applied by Bureau veterinarians, with only one failure to find lesions of tuberculosis on post-mortem examination, the percentage of accuracy being 99.21.

Properly prepared tuberculin applied by competent persons is thus shown to be a wonderfully reliable agent for diagnosing tuberculosis. In cases where the test appears to give unsatisfactory results this is usually due to the use of a poor quality of tuberculin or to ignorance or carelessness in applying it.

The following table shows the result of the tests above referred to, arranged according to States:

RESULTS OF TUBERCULIN TESTS OF CATTLE BY STATE AND FEDERAL OFFICERS WITH TUBERCULIN PREPARED BY THE BUREAU OF ANIMAL INDUSTRY, 1893, TO JULY 31, 1908, INCLUSIVE.

States.	Number of Cattle tested.	Number Reacting.	Percentage Reacting.	Number of Reactors Slaughtered.	Number found Tuberculous on Post-mortem.	Percentage found Tuberculous on Post-mortem.
Alabama	20					
Arizona	49	16	32.65	16	16	100.00
California	9,618	1,112	11.56	872	872	100.00
Colorado	822	50	6.08	14	13	92.86
Connecticut	6,080	852	14.01	750	748	99.73
Delaware	7	..	..	..	..	..
District of Columbia	8	7	87.50	5	5	100.00
Florida	1	..	..	..	..	..
Georgia	49	19	38.78	..	..	..
Idaho	10	..	..	..	..	..
Illinois	7,120	790	11.09	619	597	96.45
Indiana	2,935	246	8.38	129	127	98.45
Iowa	4,020	778	19.35	239	220	92.05
Kansas	120	4	3.33	4	3	75.00
Kentucky	327	37	11.31	13	12	92.31
Maine	3,264	149	4.56	116	109	93.97
Maryland	58	8	13.79	6	6	100.00
Massachusetts	86,223	11,853	13.75	10,760	10,688	99.34
Michigan	2,155	351	16.29	97	95	97.94
Minnesota	60,733	3,031	4.99	172	135	78.49
Mississippi	133	9	6.77	..	..	..
Missouri	1,680	133	7.92	4	4	100.00
Montana	62	25	40.33	2	1	50.00
Nebraska	105	49	46.67	18	18	100.00
New Hampshire	164	20	12.18	19	19	100.00
New Jersey	3,293	828	25.14	584	579	99.15
New Mexico	196	1	.51	1	1	100.00
New York	4,034	565	14.00	533	532	99.81
North Carolina	1,207	208	17.23	43	28	65.12
North Dakota	702	130	18.52	13	13	100.00
Ohio	2,933	425	14.49	69	68	98.55
Oklahoma	385	4	1.04	2	2	100.00
Oregon	1,466	351	23.94	274	266	97.05
Pennsylvania	90	25	27.77	7	7	100.00
Rhode Island	653	125	19.14	104	104	100.00
South Carolina	395	40	10.12	1	1	100.00
Tennessee	88	7	7.95	..	..	..
Texas	76	..	..	..	..	..
Utah	120	21	17.50	12	12	100.00
Vermont	162,570	10,628	6.54	8,248	8,166	99.00
Virginia	899	158	17.58	101	98	97.03
Washington	2,779	455	16.37	10	8	80.00
West Virginia	60	13	21.67	12	12	100.00
Wisconsin	32,297	3,477	10.77	915	802	87.65
Wyoming	2	..	..	..	..	..
Total	400,008	37,000	9.25	24,784	24,387	98.39

In this compilation the following basis has been adopted in determining what constitutes a reaction, as in the experience of the Bureau of Animal Industry this method has been found to give reliable results: A reaction consists of a rise of 2° F. or more above the highest temperature before injection, provided the maximum temperature after injection reaches 103.8° F.

It should also be explained that the number of tests shown in the table represents only those of which the Bureau received reports, and not the entire number of doses of tuberculin prepared and distributed by the Bureau during the period named.

Assuming that 10 per cent. represents the prevalence of tuberculosis among dairy cattle as indicated by tuberculin tests, and 1 per cent. among cattle slaughtered for beef as shown by the meat-inspection figures, and taking 21,194,000 as the number of milch-cows and 50,073,000 as the number of other cattle in the United States on January 1, 1908, as estimated by the Bureau of Statistics of the Department of Agriculture, we conclude that as a general average about 3.5 per cent. of the cattle of this country are affected with tuberculosis.

Economic Losses from Animal Tuberculosis.—While the financial loss caused by tuberculosis of farm animals cannot be calculated with exactness, a study of the subject affords a basis for estimates sufficiently close to show that it is a serious drain on the live-stock industry.

Loss on Tuberculous Animals Slaughtered.—The writer recently made an effort to collect reliable data as to the loss caused by tuberculosis in animals slaughtered under government meat inspection. Carefully compiled figures were obtained from a number of large firms engaged in the slaughtering and meat-packing business, in one instance the calculations covering an entire year's business. In arriving at the loss the general method, in brief, was to deduct from the average cost of a live animal of a certain class the average amount realized from a tuberculous carcass of that class, the difference representing the loss.

Under the inspection system the animals found tuberculous are disposed of in three classes, according to the extent of the disease. Carcasses which show very slight infection may often be safely passed for food after the removal of the lesions, the loss in such cases, of course, being small. Other carcasses, affected to a somewhat greater degree, but still not badly diseased, are allowed to be rendered into lard or tallow at a sterilizing temperature after all diseased portions have been cut away and condemned. In these cases the loss is more considerable. A third class comprises carcasses that are considered unfit for food in any form and are totally condemned. The loss on these is still greater, amounting in the case of cattle to about three-fourths of the cost. The salvage consists of the hide, grease, fertilizer, etc

The loss on condemned adult cattle was found to vary from $10 to $75 a head, according to grade, price, weight, etc. While the loss per carcass is, of course, heavier on the higher priced animals, the proportion of condemnations is much greater among the cheaper grades. After weighing these factors and studying the figures the writer has concluded that for the purpose of this paper the condemned cattle may be grouped in two general classes, one representing about the average of the better grades, including those known as native and western cattle, in which steers largely predominate, and the other representing the cheaper grades and lighter weights, including "cutters" and "canners," largely cows. At present Chicago market prices, the loss on the first class, when condemned, is estimated at $45 a head, and on the second class at $18 a head. These figures are believed to be conservative, and below rather than above the actual losses, as are all the estimates made in this article. It is also estimated that two-thirds of the condemnations occur in the cheaper class of cattle and one-third in the higher class. This proportion gives $27 a head as the general average loss on condemned cattle. On carcasses rendered into tallow the average loss is estimated at $20. On a percentage basis the combined average loss on cattle carcasses condemned and those rendered into tallow is about 70 per cent. of the cost of the live animals. The loss on beef carcasses passed for food is very slight, being estimated at 50 cents each.

The loss on calves condemned is about $7 a head, and the loss on those passed for food after condemning an organ or part is estimated at 25 cents a head.

The average loss on tuberculous hogs is estimated at $8.50, or 55 per cent., on those condemned, $5.75, or 38 per cent., on those rendered into lard, and 50 cents on those passed for food.

Applying the foregoing figures to the number of animals found tuberculous in the Federal meat inspection during the fiscal year ending June 30, 1908, the annual loss is as follows: Cattle, $710,677; hogs, $1,401,723; sheep and goats, $35; making a total of $2,112,436. The significance of this loss may be better appreciated when it is known that tuberculosis is the cause of two-thirds of the entire loss resulting from condemnations at the time of slaughter in the meat-inspection service.

The loss on animals slaughtered without Federal inspection cannot be so readily computed. Some States and municipalities have more or less efficient inspection systems, but the great majority of the animals slaughtered without government inspection are not subjected to inspection of any kind, and it has already been pointed out that tuberculosis is doubtless more prevalent among them than among those coming under Federal inspection. It is safe to say, however, that without inspection the actual loss is very slight. Nevertheless the writer is of the opinion that the loss should be

computed as it would occur under efficient inspection. Applying to the number of animals slaughtered without Federal inspection the same factors that were used for those coming under inspection, but assuming that the cattle are generally of an inferior quality and worth 25 per cent. less, it is estimated that the loss because of tuberculosis among animals slaughtered without government inspection would, if proper inspection were applied, reach $1,720,000 a year, making the aggregate estimated loss on all food-animals killed in the United States $3,832,436 annually.

Depreciation in Value and Other Losses.—Aside from the loss on animals slaughtered, tuberculosis unquestionably causes a considerable depreciation in the value of those remaining alive. There are no definite data upon which to calculate this depreciation, but it is entirely reasonable to estimate that tuberculous milch-cows decrease in value annually at least one-tenth of what the loss would be if they were slaughtered and condemned, while other cattle depreciate annually one-third, and hogs one-half of such loss. On this basis, taking the estimate of the Bureau of Statistics of the Department of Agriculture as to the number and value of farm animals in the United States January 1, 1908, and assuming that 10 per cent. of dairy cattle, 1 per cent. of other cattle, and 2 per cent. of hogs are tuberculous, the total annual depreciation is no less than $8,049,998.

Tuberculosis also has the effect of decreasing the productiveness of dairy cows by diminishing the yield of milk as well as in some cases by shortening their lives and consequently the period during which they produce milk. Again, the amount of the loss is largely a matter of conjecture, but the writer feels that he is within reason in estimating that the average milk yield of a tuberculous cow is 10 per cent. less than that of a healthy cow, and on this basis the annual loss, valuing milk at wholesale prices, is $1,150,000.

Serious damage is caused by tuberculosis from the standpoint of breeding. The disease is found to a greater extent in pure-bred herds than in common stock. In adding fine animals, with a view to "breeding up" his herd, an owner may unwittingly also introduce tuberculosis, with disastrous results. By causing unthriftiness and impairment of fecundity, the disease has an adverse effect upon the number and value of the offspring.

The influence of tuberculosis toward increasing the cost of meat and dairy products has already been alluded to. There is also a considerable economic loss resulting from the destruction of cattle in the efforts already being made in some States to eliminate the disease. The trade in live animals and in animal food products also suffers losses because of tuberculosis. Doubtless there are still other sources of loss chargeable to this disease in live-stock, such as the expense of maintaining a sanitary service, disinfection of premises, etc.

The Aggregate Loss.—Taking into consideration the various items men-

tioned, the tribute which the United States pays each year to this scourge among its farm animals aggregates more than $14,000,000. Such a loss is too great, merely as a matter of economics, to be allowed to continue and increase from year to year. And when, in addition, we consider the bearing of animal tuberculosis on human health, it seems imperative that vigorous measures should be taken to eradicate the disease from our herds, especially when such eradication seems entirely possible and practical.

The Control and Eradication of Tuberculosis.—Any efforts to reduce or control tuberculosis of live-stock in order to be of lasting value must have eradication in view as the final object. We should not temporize with such an insidious malady, but should adopt aggressive measures that will insure success within a reasonable time.

It has been clearly shown by the work of the Bureau of Animal Industry and by other investigations that hogs readily contract tuberculosis from cattle, and that diseased cattle are the primary source of the infection in hogs. The main problem, therefore, is to eradicate the disease in cattle, and when this is accomplished, tuberculosis may easily be eradicated from hogs.

The eradication of animal tuberculosis may as well be recognized at the outset as a tremendous undertaking which will require not only the best efforts of the authorities in charge, but the sympathy and support of stock-owners and the general public. Large sums of money will be necessary, and in order that adequate appropriations may be obtained, the necessity and importance of the work must be generally realized and understood.

What May be Done by Individuals.—Much can be done by the individual stock-owner, with proper assistance, to exclude and eliminate the disease from his animals. He should be careful to avoid the introduction of tuberculosis into his herd by requiring that any cattle purchased shall have passed the tuberculin test. He can also do much to promote the health of his animals by keeping them in sanitary stables and under hygienic conditions. When tuberculosis is suspected, he should notify the authorities and have his cattle tested. When the presence of the disease is known, the safest course is to have the affected animals slaughtered, but in the case of valuable breeding stock, where slaughter would involve great sacrifice, the Bang system of segregation may be used.

Educational Work.—The individual, however, must first be aroused as to the danger of having tuberculosis in his herd and the importance of eradicating it, and he must also be informed as to the nature of the disease and the best methods of combating it. Valuable work in this direction may be done by the general and agricultural press and by official publications, also by lectures at public gatherings, farmers' institutes, etc.

Government and State Measures.—If the campaign for the eradication of

animal tuberculosis is to be comprehensive, systematic, and generally successful, it must be directed by Federal and State officials, conjointly, who must be armed with adequate laws and funds and supported by public opinion. Excellent work has been done by the authorities of several States during recent years, but a study of the laws and regulations of all the States shows that in most of them the importance of the subject is not appreciated. Thirteen of the States at present require the tuberculin test on cattle brought in, this requirement usually being limited to cattle intended for dairy or breeding purposes. Fourteen States have provisions for the slaughter of animals found affected with tuberculosis and the payment of indemnity to the owners, while a few others give authority for condemnation and slaughter without making provision for indemnity.

The work of the Federal government, as carried on by the Bureau of Animal Industry, so far consists in supplying tuberculin free of charge to State officers, in endeavoring to prevent the interstate shipment of tuberculous animals, and in tracing, when practicable, the origin of animals found affected with tuberculosis in the meat-inspection service, and notifying State authorities.

As a basis for further work Federal and State authorities should first determine to what extent and in what localities tuberculosis exists to the greatest extent among live-stock (where this has not already been done), and should first apply the tuberculin test generally and systematically to cattle in such sections.

The safest way of disposing of reacting animals, as previously stated, is to slaughter them. In order to reduce the financial loss to a minimum and at the same time guard against the sale of unwholesome meat, it is well to have such animals slaughtered at abattoirs under Federal or other competent veterinary inspection. In this way a large proportion may be safely passed for food and made to yield their full meat value, while only those whose meat may be dangerous to health will be condemned.

In herds where the disease is found it is advisable to repeat the tuberculin test at intervals of six months, and after the disease has apparently been wiped out, the test should still be applied once a year until it is known that infection does not remain and has not been reintroduced. Inspectors should be stationed at important points for the purpose of testing cattle for breeding and dairy purposes, and each State that is endeavoring to eradicate the disease should require that no cattle for breeding or dairy purposes shall be admitted from without the State unless they have passed the tuberculin test. A good method of preventing the spread of tuberculosis among breeding stock would be the establishment by the State of one or more free herds of breeding cattle for the use of stock-raisers in the State, or the State could certify to the health of free herds.

An effective means of locating and eradicating tuberculosis of live-stock would be to establish by State legislation a system of tagging cows sent to market from infected districts for slaughter, so that when any are found tuberculous in the meat inspection, they may be traced back to the place of origin, centers of infection located, and steps taken for eradication. The Bureau of Animal Industry is already coöperating with the authorities of some States by reporting on tuberculous animals, and the results so far have been very encouraging. To give the plan general application, authorities should be empowered by law to require that shippers shall tag their cows in such a way that they may be identified and their origin determined.

As the eradication of tuberculosis is largely a public health measure, it is only reasonable that the State should compensate, at least in part, the persons whose cattle are slaughtered. This is not only fair, but it is absolutely essential if the coöperation of the cattle-owners is to be secured.

It will be seen from the methods above discussed that in carrying on work for the eradication of animal tuberculosis in the United States, hearty coöperation and concurrence of action between the Federal and State governments will be essential. Under the Constitution the power of the Federal government in such matters is limited to those aspects which concern interstate commerce, and if a State fails to do its part, the Federal government cannot step in and carry on the work. What the Federal government can do in such a case, however, is to quarantine the State or a portion of it, and thus prevent the movement of animals from such a State; but while this action would protect other States, it would not help the situation within the State.

Benefits of Eradication.—The economic advantages of eradicating tuberculosis from farm animals are too apparent to require extended discussion. They will come to the individual stock-raiser and dairyman as well as to the public and the nation. Breeders are beginning to understand that it is unprofitable to go on raising cattle while tuberculosis exists in their herds. The practice is becoming more general for buyers of breeding and dairy cattle to have such animals tested before placing them in their herds, and the breeder who can give assurance that his herd is free from tuberculosis has a decided advantage in making sales. With the agitation in favor of a more wholesome milk-supply there is coming a growing demand for milk from healthy herds at higher prices, and as this demand increases, the dairyman who cannot show a clean bill of health for his cows will find it more difficult to market his products.

To overcome the losses above enumerated is worth considerable effort and expense. The benefits to follow from the eradication of tuberculosis from farm animals are so great and so obvious that the necessary expenditures, even though they must be heavy, may be regarded as a highly profitable investment.

ECONOMICS AS A POSITIVE FACTOR IN THE DISSEMINATION OF TUBERCULOSIS IN ANIMALS.

By O. E. Dyson, M.D.C.,
Chicago, Ill.

Economics as a positive promoting factor of the wide and constantly increasing spread of tuberculosis in domesticated food-producing animals, and in milch-cows especially, has never been candidly considered in its true light; otherwise, it would not be given greater consideration than that of the primary cause, of which the world was in ignorance until enlightened by Prof. Koch, who not only succeeded in demonstrating that the tubercle bacillus had a material existence, but that, from the standpoint of contagion, it was dependent upon bacterial laws requiring the primary existence of a host, thus precluding the possibility of its spontaneous origin.

The fact has also been clearly demonstrated that the contagion of tuberculosis promptly surrenders to the operation of hygienic and sanitary control, the principles of which are based upon a logical conception of the immutable laws of cause and effect. Notwithstanding this, however, the question of economics involved has been given more consideration than the cause, with the result that little or no rational effort has been made toward the eradication of tuberculosis in animal species, and particularly in dairy cows—a positive and well-known source of contagion permitted to exist only through lack of public sentiment being intelligently and authoritatively directed to the facts as they exist.

That public sentiment has been and still is subservient to the question of economics, involved in the matter of eradicating tuberculosis, can only be explained by reason of the fact that while tuberculosis is by far the greatest existing menace to public health and live-stock interests, its manifestations are insidious rather than epidemic, and resulting deaths in the human family occur with uniform regularity and in definite ratio to the population; in contrast to sudden outbreaks of other contagious or infectious diseases which quickly kill comparatively few before being eradicated by the application of modern sanitary and hygienic principles enacted into laws and rigorously enforced.

The same status of affairs, relatively speaking, exists with reference to food-animal species, with exception of the fact that tuberculosis is seldom,

if ever, the direct cause of death; in contrast to sporadic outbreaks of other contagious and infectious diseases. Consequently tuberculous animals, and milch-cows especially, even though extensively affected with a generalized form of the disease, unless subjected to the tuberculin test are seldom detected until slaughtered, and then only under the more than efficient supervision of the Federal Meat Inspection Department. Previous to slaughter, through the cupidity of their owners and negligence on the part of State and Federal legislators, such diseased animals are permitted to serve as an unrestricted source from which the infection of tuberculosis is spread to others of their kind, including hogs, and also, no doubt, through milk and butter products to susceptible individuals of the human race—with the ultimate result that even the economic loss resulting in the final condemnation of the affected animal carcass, when slaughtered under Federal inspection, is thrown upon the shoulders of those who are in nowise responsible for the infection; whereas if the economic losses annually sustained as a result of the disease in animals could be placed where they rightfully belong,—that is, upon the producer,—the eradication of tuberculosis in dairy herds and other food-producing animals would be a question of but a few years, and public health, now constantly endangered as a result of existing conditions, would be protected.

On the other hand, if a municipality, State, or the Federal government could be held responsible to the extent of five or ten thousand dollars for the death of every individual caused by the effects of tuberculosis, tax-payers, in order to relieve themselves of an unnecessary economic burden, would not hesitate to quickly and authoritatively direct that prompt and effective steps be taken toward the eradication of tuberculosis in dairy cows and pure-bred cattle herds, with the object of reducing its prevalence in man.

From an economic point of view tuberculosis constitutes a mortgage of the Shylock variety upon a large percentage of the cattle and hogs now produced in this country. Upon that mortgage at least five million dollars must be paid as an annual interest charge. Of this amount, three million dollars may be charged to losses sustained through the condemnation of affected food-animal carcasses as a result of our present system of United States meat inspection, which is conducted at a cost to the Federal government of three million dollars per annum, two-thirds of which would be an unnecessary expense were it not for the prevalence of tuberculosis in animals. Therefore, the sum of $5,000,000 per annum may be charged directly to failure on the part of legislators of various States and the Federal government to recognize the fact that tuberculosis is a preventable disease, and that it could be eradicated by a logical application of modern sanitary laws coupled with hygienic and economic principles, thereby eliminating such losses entirely within the next few years.

As a precedent in substantiation of the above claim may be cited the fact that more highly contagious forms of disease—namely, contagious pleuro-pneumonia and foot-and-mouth disease in cattle—have been promptly eradicated by the application of rational sanitary laws and economic principles, in face of the fact that little was known then, or even now, concerning the specific cause of their contagion, in contrast to the well-known principles involved in the spread of tuberculosis. Therefore is it not reasonable to claim that in case diseases due to unknown causes can be completely eradicated by the application of well-known sanitary laws and economic principles, tuberculosis, being much less contagious and comparatively easy to control, should at least be eradicated from all animal species?

Furthermore, while the health of consumers of United States inspected and passed meats and meat food-products is protected against a remote possibility of tubercular infection from that source, at a total expense of approximately five million dollars per annum, practically nothing is spent by many States or the Federal government to protect the consumers of milk and milk food-products derived from cows known to be affected with tuberculosis, when such products are unquestionably admitted by all recognized authorities to be a thousand times more dangerous to consumers than the flesh of the affected animal. And yet such products are generally permitted to be locally consumed and to enter into interstate trade without the slightest restriction.

This condition of affairs should also be coupled with the fact that more than 90 per cent. of the carcasses of all cattle condemned under the operation of the United States Meat Inspection Act are those of cows condemned on account of tuberculosis, and that the percentage of such cattle never constitutes more than one-third of the total number of cattle officially inspected at the time of slaughter; thus unquestionably leaving fully two-thirds of the total number of diseased cows to be slaughtered by local butchers throughout the country, who regularly dispose of the flesh of such diseased carcasses to unsuspecting consumers, who have also, perhaps for years, consumed milk and butter products derived from such tuberculous cows, in blissful ignorance, or with little thought of the possibility, that they were consuming or that they were perhaps feeding a disease-infecting food-product to helpless children who were unable to make known their wants in the matter of food selection with reference to its purity and wholesomeness. How many children's lives have thus been sacrificed in infancy, due to the cupidity of dairymen, and ignorance on the part of parents, will never be known, nor is it possible to estimate the number of adults infected as children, and thereby destined to sacrifice their lives as a result of ignorance on the part of political representatives, avarice and greed on the part of dairymen and the owners of pure-bred cattle herds, who to-day are resisting with all their might

any interference with their present privilege of peddling the contagion of tuberculosis broadcast throughout the land, by and with the full knowledge of legislators, both State and Federal, who are willing to juggle with the cause of a death-dealing infection apparent on every hand. Lack of specific knowledge may be claimed by legislators in answer to the above accusation. If so, then they are clearly unfit to hold an office where the future welfare and even the lives of people living in their respective districts are necessarily to a great extent endangered as a result of their representative's lack of information.

What can be said in favor of State legislators and municipal authorities who knowingly permit unscrupulous dairymen to sell the products of a diseased dairy herd to unsuspecting consumers?

What incentive is offered to the owner of a dairy herd that is free from disease, to keep it so, when he must meet in competition the products of a diseased herd?

What can be said in favor of the large and influential pure-bred cattle-producers of this country, who always have and will, no doubt, indefinitely continue to oppose the enactment of any laws which would in any way curtail the privilege or the resulting profit which they have long enjoyed, through being permitted to scatter the infection of tuberculosis throughout the country by selling diseased animals at fabulous prices to unsuspecting purchasers, who in turn allow the disease a further unrestricted spread?

What can be said in favor of a pure-bred cattle-breeders' association, organized ostensibly for the purpose of improving or maintaining the purity of a breed, which will permit the registration of animals from herds known to be affected with tuberculosis, thereby advancing the cause of tubercular infection? And why do most of these associations oppose all efforts on the part of progressive States and the Federal government to enact laws by which this disease could be eradicated?

What can be said in favor of State laws which require a certificate of health for all breeding cattle or milch-cows shipped into the State, and permit without question the unofficial administration of the tuberculin test, and the sale of reacting cattle within the State, or the shipment of diseased animals from the State to other States which have failed to protect themselves by the enactment of similar laws?

Great efforts have been made to improve the breed of cattle in this country without regard as to whether or not they were affected with tuberculosis. What is accomplished by wasting time and feed upon diseased cattle, when one healthy scrub steer, if purchased subject to post-mortem inspection under the present regulations of the United States Meat Inspection Department, would have a market value many times greater than a large number of

pure-bred steers which regularly win prizes at State fairs and live-stock expositions?

What can be said in favor of the management of State fairs and live. stock expositions, which are supposed to encourage the advancement of live-stock interests, when premiums in the cattle classes are awarded indiscriminately to diseased and healthy animals, and no precautions taken to protect a healthy animal from becoming infected with tuberculosis by being exposed to those which are diseased and unfit for any purpose other than deceptive exhibitions of merit? How can live-stock interests be advanced by the awarding of prizes to tuberculous animals, when a tuberculin test and a certificate of health would prevent such a common infraction of justice?

In contrast to the above-mentioned facts as they prevail may be asked: Why is it that horses with a slight physical defect, such as a splint, are rejected at such expositions in favor of sound animals of otherwise less merit? Simply and solely for the reason that the defect is apparent to even the casual observer, and affects to a certain degree the market value of the animal. To judge cattle by the same standard, it is admitted by the managers of live-stock expositions and others well informed, would result in excluding fully 50 per cent. of practically all pure-bred herds from participating in such shows. How long such deception will be permitted to last, in the face of its economic status, can only be surmised.

What can be said of the mental caliber or the integrity of any man, regardless of his ownership of a herd of tuberculous cattle, or the fact that he may be at the head of an agricultural college, a State or Federal legislator, or the publisher of a live-stock journal, when he, without hesitancy, is willing to cast aside and endeavor to discredit the accumulated knowledge of time and a host of pioneers in the field of research and experiment with reference to the efficacy of tuberculin as a diagnostic agent when properly administered? Such men would, no doubt, if opportunity afforded, mortgage posterity to the ravages of an everlasting plague and call it "self-protection"; or prate the fact of their loyalty to friends or political constituents who are economically interested in the further development of tuberculosis in dairy and pure-bred cattle herds.

The excuse of ignorance might possibly be advanced to the credit of all such men, with the exception of the publisher of a live-stock journal. With him, such an attitude is merely an evidence of a conscience warped in the direction of an economic gain to be secured at the expense of public health and ignorance, by the sale of advertising space to well-known breeders of diseased cattle, who are thus enabled to sell to credulous purchasers animals which, on account of disease, are unfit for either food or milk production, and only serve to depreciate the value of any herd to which they may be added on account of the contagion which they invariably spread.

How is it possible to advance the live-stock interests of this country if the live-stock journals, which profess to have the interests of the producer at heart, cannot be trusted to assist in guarding, or at least advising, their patrons against the purchase of diseased animals for the purpose of an effort to improve their herds? As a result of existing conditions the average producer is being constantly buncoed by the purchase of cattle of the gold-brick variety, which are regularly and extravagantly advertised in live-stock journals, much to the detriment of the live-stock interests at large.

Such is the situation now before us, which fully discloses the prevailing influence of economics in its relation to the spread of tuberculosis in animals. The time, however, is not far remote when there will be a full awakening of public sentiment to the facts as they exist. Then, and only then, can it be expected that the question of economics, in which comparatively few are concerned, will be substituted in favor of a demand for the protection of live-stock interests and public health—the latter unquestionably being a municipal, State, and national liability, and as such should be protected to the extent of utilizing modern achievements in the world of hygiene and sanitary science resulting from a knowledge of cause and effect.

In this connection, who would care to consume the products of a dairy cow known to be diseased, regardless of a positive knowledge of the transmissibility of tubercular infection from animal to man? And what authority can be cited as to the possibility of a child having more resistance to tubercular infection from infected milk than a hog, which every veterinarian knows to be highly susceptible to the infection? Therefore, would it not be well for medical authorities to coöperate with the veterinarians in efforts to remove possibly the principal source of tubercular infection to which the human is to-day exposed, rather than to depend upon sanatoriums and fresh-air funds to cure the disease after infection has taken place, with little or no possibility of such resources ever being able to keep pace with the present unrestricted sources from which the contagion of tuberculosis spreads?

Little can be said in favor of knowledge unapplied, as evidence of knowledge depends alone upon its practical application; therefore, unless the well-known and time-proved methods of successfully dealing with the question of eradicating tuberculosis can be applied now, the question of economics involved will later assume such huge proportions as to practically eliminate any further thought of eradicating the disease in animals; in proof of which the prevailing conditions in some of the European countries with reference to the disease may be cited as a logical sequence.

The eradication of tuberculosis in animals in this country unquestionably depends upon the enactment and rigorous enforcement of Federal laws to prevent the interstate shipment of any animal of the bovine species intended for breeding or dairy purposes, unless subjected to the tuberculin test and

authoritatively certified to as being free from disease. In addition to which, as a further incentive to various States to protect their own interests, and incidentally public health, the interstate shipment of milk and butter products should also be prohibited unless derived from cows known to be free from disease. The effect of such legislation and its enforcement would, no doubt, be to confine within each State the operations of many well-known promoters of tuberculosis in animals and probably the disease in the human race. Thus, by depriving these active agencies of a large proportion of the pecuniary profits they now enjoy, regardless of the welfare of others, the natural result would be to cause owners of tuberculous cattle to actively enlist their services and political influence in favor of the cause which they have so long and so successfully fought.

In order to prove that the eradication or control of tuberculosis in pure-bred cattle and dairy cows would serve a double if not a triple purpose, it is only considered necessary to cite the fact that they are almost invariably responsible for the infection of stock cattle and hogs. As these animals seldom, if ever, further transmit the disease to others of their kind, it is evident that by eliminating the principal source of their infection the disease in such animals would soon become eradicated as a result of their being consigned to slaughter at an early age. In addition to this, tubercular infection of our milk and butter products might also be guarded against.

History conclusively proves that no advance steps toward signal accomplishments in the matter of public health or the future welfare of the human race have ever been taken except by those who at the time of the initial movement were considered radical. Therefore, inasmuch as history, in order to be progressive, must repeat itself, no progress can or will be made toward the eradication of tuberculosis until radical steps are taken—after which conservatism will find its place.

La question économique comme facteur positif de la dissémination de la tuberculose chez les animaux.—(Dyson.)

La question économique n'a jamais été considérée par son vrai côté; autrement la tuberculose, comme d'autres maladies plus contagieuses encore pourrait être déracinee en un temps relativement court, par la seule application des principes modernes sanitaires et économiques.

Jusqu'à présent, l'influence économique des propriétaires de bétail de pur sang et de ces troupeaux de ferme qu'on sait être affectés de tuberculose, a, par des moyens politiques, empêché les législateurs des états et les législateurs fédéraux, de passer des lois nouvelles, nécessaires pour combattre le trafic des animaux malades ou les produits de laitage provenant de troup-

eaux infectés. En outre, les propriétaires des vaches malades ont réussi à empêcher l'application des lois déjà votées, qui seraient appliquables et qui pourraient avoir de bons résultats.

Contre la propagande anti-tuberculeuse une campagne a été menée par ceux qui étaient économiquement intéressés à répandre la maladie dans tout le pays; à cette campagne ont pris part les propriétaires de bétail pur sang, des troupeaux de ferme et les associations des marchands de bétail avec lesquelles ils sont alliés. Ensuite, on vit dans cette campagne les administrations des foires des états et des expositions d'animaux, les administrateurs pensant sans doute que les bêtes saines ne doivent pas être appréciées davantage que les malades, alors que vient le temps de la distribution des prix annuels. Enfin, "last but not least," cette campagne a été supportée par les journaux, qui vivent en protégeant les intérêts des marchands de bétail, auxquels il vendent leurs pages pour faire la réclame aux bêtes tuberculeuses, lesquelles peuvent être vendues ainsi, à des prix fabuleux; comme conséquence de ce trafic, les acheteurs, crédules, à leur tour, permettent à la maladie de se répandre plus loin. Et on demande aux rédacteurs de ces journaux, quoiqu' eux-mêmes soient bien informés sur les dernières données scientifiques, de discréditer les resultats de la science et de discréditer tous les pioniers de la recherche et des expériences, afin que les lecteurs ne croient pas à l'efficacité diagnostique de la tuberculine, efficacité certaine quand celle-là est proprement administrée.

L'extirpation de la tuberculose chez l'homme et chez les animaux dépend sans nul doute d'un arrangement tel, qu'il y ait un intérêt économique à la santé; le résultat serait que le savoir remplacerait l'ignorance et de là résulterait la soumission inconditionnée à l'application de l'hygiène moderne et de la science, délivrée de la mauvaise influence politique et de la cupidité des propriétaires de bétail pur sang et de troupeaux de ferme.

Selbstsüchtige Sparsamkeit als ein Faktor der Verbreitung der Tuberkulose unter Tieren.—(Dyson.)

Es wird gezeigt werden, dass Sparsamkeit nie in ihrem wahren Lichte betrachtet worden ist, andernfalls könnte Tuberkulose gleich anderen ansteckenden Krankheiten in einer verhältnismässig kurzen Periode durch die Anwendung moderner sanitärer und ökonomischer Prinzipien ausgerottet werden.

Der Einfluss der Sparsamkeit in den Händen der Eigentümer reinblütiger Rinder- und Milchviehherden, von denen man weiss, dass sie von Tuberkulose befallen sind, hat bisher durch politischen Einfluss Staats- und Bundes-Gesetzgeber abgehalten, hinzugefügte und notwendige Gesetze passieren

zu lassen, um den Handel mit erkranktem Vieh oder den Milch- und Butterprodukten von angesteckten Viehherden zu verhindern. Im Zusatze dazu sind die Eigentümer erkrankter Herden in der Verhinderung der Durchführung angenommener Gesetze durch Staats- und Bundes-Autoritäten erfolgreich gewesen, die anwendbar sind, und mit guten Resultaten angewendet werden konnten.

In dem Feldzuge der gegen die Ausrottung der Tuberkulose von diesen durch selbstsüchtige Sparsamkeit Beeinflussten und der dadurch verursachten Verbreitung über das Land haben sich die Rinder- und Herdenbesitzer und die mit ihnen verbundenen Versicherungsgesellschaften in eine Linie gestellt. Als nächstes kommen die Veranstaltungen staatlicher Feste und Vieh-Ausstellungen, welche ganz bestimmt auf dem Standpunkte stehen, dass gesunde Tiere nicht mehr Berücksichtigung erhalten sollten als die erkrankten, wenn es gilt, Preise bei ihren jährlichen Vorführungen zu erlangen. Last, but not least, kommt die nahezu einmütige Unterstützung der interessierten Zeitungen, welche sozusagen ihren Unterhalt durch den Verkauf ihrer Reklamespalten an die wohlbekannten Eigentümer erkrankter Herden beziehen, die dadurch in Stand gesetzt sind, erkrankte Tiere zu fabelhaften Preisen an leichtgläubige Käufer zu verkaufen, die dadurch der Krankheit eine weitere Verbreitung in uneingeschränktem Masse sichern. Wenn dadurch in der Unterstützung einer solchen selbstsüchtigen Sparsamkeitspolitik von Seiten der Herausgeber solcher sich mit Viehzucht beschäftigenden Zeitungen selbst gegen ihre bessere Überzeugung gedrängt sind, die angesammelte Kenntnis und die Pioniere auf dem Feld der Ausforschung und Experimentierkunde mit Rücksicht auf die Wirksamkeit des Tuberkulins als ein diagnostisches Agens, wenn richtig angewendet, in Misskredit zu bringen, wird man sich kaum über die traurigen Resultate wundern können. Die Ausrottung der Tuberkulose in Mensch und Tier hängt fraglos von einer richtigen Verbindung mit ihren nationalökonomischen Beziehungen der Gesundheit ab, welche zur Folge haben musste, dass Kenntnis die Ignoranz verdrängt, wodurch bedingungslose Möglichkeiten für die Anwendung moderner Hygiene und Gesundheitslehre geschaffen wurde, frei von dem gepriesenen politischen Einflusse und der Habgierde der Herdenbesitzer.

DISCUSSION.

Dr. Moore (New York): I would like to ask Dr. Melvin about the number of tuberculous animals—whether the statistics mentioned in his paper represent the number of condemned or infected animals?

Dr. Melvin: The total number that were infected, that is, with reference to meat inspection.

Dr. Pearson: Dr. Melvin has brought out the first statement as to the approximation of the money losses that I have ever seen. I think he presented for the first time an estimate of the actual loss as a direct result of the disease. His estimate was something more than $8,000,000. There are other losses which might very properly be brought into the estimate, such as those sustained by breeders, which are very discouraging. These men have often given up breeding, owing to the loss due to this disease. There is not only a loss to the breeder, but there is also a great loss to the public in general. Everything that diminishes the efficiency of the live-stock industry tends to reduce the price of live-stock.

Dr. Dawson (Delaware): I have been struck with the enormous losses resulting from the disease as pointed out in these papers, and yet they do not represent all the losses, since they do not include the cases of natural deaths of animals from tuberculosis. By including this item it would show a considerable increase in the prevalence of the disease. This is particularly true of Texas fever in the South.

Dr. Pearson: This is a natural item which was not included in Dr. Melvin's paper.

Dr. Ward (California): I wish to state an experience which came under my observation in California, where two breeders of Holstein cattle had to go out of business due to the losses from this disease. It is evident that these animals were passed on to the next fellow, and these herds were known to be affected with tuberculosis. Thus, in this way it will readily be seen how the disease can be disseminated.

Dr. Nelson (Washington): The items included in these reports are certainly very astounding—$8,000,000 a year. They indicate the enormity of the losses resulting from the effects of tuberculosis. It is pretty hard to appreciate these facts, much less to discuss them. These papers contain such prominent and definite facts that it is more for observation than discussion. What are we going to do about it? It should bring about a determined action of the profession toward educating the general public and dairymen to thus control the disease with their coöperation.

Dr. Rogers (Kansas): Apropos of Dr. Dyson's remarks upon advertising space given to pure-bred breeders; in 1905 I proposed that the Post-office Department should and could legitimately refuse second-class mail privileges to papers that accept and print advertisements of pure-bred stock not guaranteed to be free of tuberculosis, for a fraud order would seem to be within the confines of justice and honesty as interpreted in 1908. You know about patent medicine frauds.

Prof. Arloing: I wish to inform this audience of the great interest which the French people are taking in the good work of the United States toward the control of tuberculosis in animals, and I also wish to recognize the splendid

work accomplished in the line of immunization by the honorable President of this Section. I desire to emphasize the high character of the work done by veterinarians in that direction, and to mention the importance of this disease to our profession, not alone from its economic side, but also from the standpoint of its relation to the public health.

Dr. Pearson: I have the honor to call upon Prof. Heymans with reference to the control of tuberculosis of cattle in Belgium.

Prof. Heymans: I will speak of the results accomplished in Belgium toward the controlling of tuberculosis of animals. Belgium has a population of about 8,000,000 people and about 2,000,000 cattle, of which 1,000,000 are cows, while the other million represents other cattle. The tuberculin testing was put into practice in 1895, and accordingly we have had fourteen years of experience with the testing for the disease in our country. Of the cows, 400,000 reacted to tuberculin, and of the other stock about 10 per cent., the average amounting to 25 per cent. Belgium has a general meat inspection law in operation, and not a single food animal is slaughtered without subjecting the same to an expert examination. The results and statistical compilations show only about 5 per cent. of the examined animals to be affected with tuberculosis, which clearly indicates the uncertainty of the macroscopical examination. Belgium as well as France recognizes the absolute reliability of the tuberculin test, and the differences in the results from this test and those of the macroscopical examination only show the imperfectness of the post-mortem examination. The Bang system was tried for the first time in 1895, and it was extensively applied under government support. In the execution of the system it was decided to destroy all reacting animals within one year after the reaction, but it was found that such a large number reacted (40 per cent.) that it was decided to extend the time limit to two years, then to three years, and finally the owners could keep the reacted animals for an indefinite time. The State allowed 50 per cent. of the market value for the condemned animals, but the losses from this source were so great that they amounted in the course of a few years to 15,000,000 francs, and with hardly any beneficial results. The failure can be attributed to the difficulty which lies in the execution of the Bang system, as the stock-owners are usually careless in the execution of this system. At the present time it is the aim in Belgium to control tuberculosis of cattle by an improved method: namely, first, to discover all tuberculous animals; second, to destroy the highly infected cases; and, third, immunization. Everything points toward better results from this latter method.

A STUDY OF THE TUBERCULOUS CONTAMINATION OF THE NEW YORK CITY MILK-SUPPLY.

By Alfred F. Hess, M.D.,
New York.

One of the most important questions to-day which confronts those fighting the spread of tuberculosis is: What proportion of infection is human in origin, what proportion bovine in origin? It is not necessary for me to review in this place the various answers that are given this question by sincere and capable workers in the same or different countries. In the United States we find Theobald Smith stating that, in his belief, not over 1 per cent. of tuberculosis is of bovine origin, and, on the contrary, others—for example, Ravenel—believing that a considerable percentage of the disease is of this origin. The British Tuberculosis Commission recently reported that "a very considerable amount of disease and loss of life, especially among the young, must be attributed to the consumption of cows' milk containing tubercle bacilli." In view of such conflicting statements on a subject of such vital importance, physicians and laymen are, at the present time, undecided whether they should concentrate their energies against the dangers from the tuberculous individual, or whether they must guard against a dual source of infection. Prophylaxis suffers from this indecision.

The object of my work was to prove one of the elemental phases of this broad question; to ascertain how often milk supplied to a large city, such as New York, contained virulent tubercle bacilli; and also to study the nature of these bacilli, to learn whether they conformed uniformly to the bovine type. I realized that the presence of tubercle bacilli in milk does not necessarily furnish an index of the frequency of infection of those who drink such milk. Nevertheless it is important that we should at the outset have an approximate idea of the incidence of tubercle bacilli in the market milk. I found experiments of this nature surprisingly few in number and conflicting in results. The New York city milk had never been investigated in this particular, and examinations which had been made elsewhere were, for the most part, incomplete, or dated back to a period when our milk was obtained under conditions quite different from those which exist at the present time. However, since I began this investigation last year a comprehensive report

of the tuberculous contamination of the milk-supply of the city of Washington has appeared, to which I shall refer in detail later. You will find the literature of this subject well abstracted in this publication.[1]

The second part of my investigation consisted in isolating in pure culture some of the tubercle bacilli found in the milk, and in differentiating them according to type. This was undertaken in order to learn whether all the cultures would prove to be bovine, as was to be expected considering their source, or whether we might find human or intermediate varieties. It seemed that the previous work in this regard should be supplemented, and that more strains should be isolated from bovine material, to judge more certainly of the distinction between the two types of bacilli.

The material was obtained in the following manner. In the tests of raw milk specimens were gathered only from the large forty-quart cans, and not from bottled milk. This was done partly because the facilities of the Health department rendered it simpler, but more especially because more than one-half of the milk sold in New York is not bottled, but constitutes the so-called "loose milk." The fact that unbottled milk forms such a large proportion of the municipal supply is sufficient in itself to warrant its selection as a basis for examination. Furthermore, loose milk and bottled milk are frequently identical, are dispensed by the same dealer, and derived from the same dairy. The specimens were collected in the same manner as those brought to the laboratory twice a week for general bacteriological examination. I used the same sterilized one-ounce bottles with a tight-fitting tin cap. The milk was taken indiscriminately from grocery stores, dairies, and large plants in the various quarters of the city. Two specimens were dipped out from each can, one for the bacterial count, another for examination for tubercle bacilli; six to twelve were collected at a time for my purposes. In most cases I obtained the milk myself. and my selection was guided merely by an attempt to obtain specimens from dealers who had small children who drank this milk. This was done with the object of determining the subsequent health of these children, and will form the basis of a paper at some future time.

In the laboratory the specimens were kept in the refrigerator. Before being opened they were thoroughly shaken and then 10 c.c. of milk were removed by means of a sterile pipette, and transferred to a small tube, in which it was centrifuged from five to seven minutes. Two smears were made from the surface of the cream, which formed a solid layer at the top of the tube. The entire cream layer, which varied in amount, was removed by a sterile copper spoon and placed in a Petri dish. The skimmed milk was poured away and disregarded, with the exception of the lowest cubic centimeter, which was poured into another dish. Two smears were made from the dregs in the centrifuge tube. These two portions of milk, the cream and the lowest cubic centimeter, were drawn into small antitoxin syringes and

injected into two guinea-pigs. It was necessary to dilute the cream with a small quantity of salt solution in order to render it fluid. As far as possible unused pigs of medium weight were employed; however, in many instances I had to use larger pigs which had served as tests for diphtheria antitoxin. In order to make certain that such pigs were not previously tuberculous, fifty which had been used in this work were autopsied. In no instance was any tuberculous infection encountered. In the early tests the inoculations were made into the muscles of the thigh, following the recommendation of Ostertag. Later, however, subcutaneous inoculations into the groin were resorted to, as the disadvantages of the intramuscular method outweighed its advantages. It was found that the deep injections frequently gave rise to hematomata at the site of inoculation, that they were sometimes followed by sudden death, and that the inguinal glands enlarged less markedly than when the pigs were inoculated subcutaneously. For each inoculation a different syringe and needle were used. The pigs inoculated on the same day were kept in the same cage. Very few abscesses developed, probably owing to the fact that almost three-quarters of the inoculations were made deep into the muscle; those which did form, did not ulcerate through the skin. The animals were examined twice a week. They were not killed after a definite period, but in some instances, where cultures were not desired, they were allowed to live long after they were known to be tuberculous. In this way we could judge somewhat of the dosage and the virulence of the tubercle bacilli in the milk.

One hundred and twelve specimens of raw milk were tested in the manner described, but as in 5 instances the animals died within two weeks of inoculation or were lost in other ways, only 107 came under consideration. The tables (Table I and II) give a summary of the results. Nineteen specimens were found to contain tubercle bacilli. It was found, however, upon tracing these samples to their source, that 2 were duplicates, so that we must consider that the positive inoculations numbered only 17. Thus the figures resolve into 17 positive tests out of 107, which means that 16 per cent. of the milk contained tubercle bacilli.

In every one of these 17 cases, as well as in the 2 duplicates, tubercle bacilli were found at autopsy. The case was looked upon as negative unless the bacilli were shown to be present. For example, the autopsy of pig No. 436, killed three months after inoculation, reads as follows:

Somewhat emaciated; large bilateral inguinal glands; mesenteric glands hard, size of small marble; slight enlargement of iliac and retroperitoneal glands, spleen three times normal, containing a caseating abscess, and miliary tubercles. Liver showed miliary tubercles, lungs negative. At the time of autopsy these lesions were considered definitely to indicate tuberculosis, but as bacilli could not be found, and reinoculation tests proved

inconclusive, the case was rejected. In most instances reinoculation into a second series of pigs was made. In order to control the results still further and avoid the possibility of confusing the tubercle bacillus with similar acid-fast organisms, cultures were made in each instance. In those cases where serum or egg media was not employed, in other words, where the object was not to cultivate the tubercle bacillus, glycerin-agar was used. In no instance was an acid-fast organism encountered.

The smears made from the cream and from the sediment, of which mention has been made before, showed no tubercle bacilli. In no slide could they be definitely made out, although in those instances in which animal inoculations had demonstrated tuberculosis the slides were carefully examined for a second time. They showed a large number of bacteria and leukocytes; roughly, about an equal number in cream and sediment, but the number was found to bear no relation to the presence or absence of tubercle bacilli in the milk (Table II).

I next examined some "commercially pasteurized" bottled milk, making use of the same technic. Eight samples were obtained from three different plants, with the intention of using more samples, should these first tests give a negative result. The dealers of this milk state that it has been subjected to a temperature of 160° F. for forty seconds. In one of the eight samples tubercle bacilli were demonstrated by animal inoculation, which proves that this method in practice is inadequate to protect us from tubercle bacilli. Investigation in this particular was pursued no further.

In conjunction with this work an opportunity was afforded of obtaining tubercle bacilli in pure culture from milk. As the question of the possibility of separating the mammalian tubercle bacilli into two definite types, as proposed first by Theobald Smith, has not been settled to the satisfaction of all bacteriologists, it seemed worth while to isolate some strains and to differentiate them. The method used in this study was that employed by me in former work in this field.[3] For the first generation dog serum or egg medium was used. The morphology of the bacilli, facility of cultivation, and virulence toward rabbits were considered mainly in the differentiation. The ability of a culture to induce a fatal generalized tuberculosis in the rabbit was looked upon as evidence of its being of the bovine type. For this test intravenous injections of a standard emulsion were made.

Seven cultures were isolated. In two other cases cultures were attempted, but failed. The result is given in tabular form (Table III). A study of this table shows that a marked uniformity of type was found. All were of the bovine variety, without doubt. One culture grew more rapidly than the others, was more eugonic, to adopt a phraseology of the British Commission, but in virulence it conformed strictly to the bovine type. The number of cultures isolated and differentiated from bovine material have not

been numerous. Their paucity has led some, who did not recognize the duality of types, to insist that more cultures from bovine sources should be studied, before we look upon this means of differentiation as a reliable criterion. The importance of this criticism is appreciated when we consider that at the present time this slow and tedious method must form our main reliance, not only in deciding whether a case of tuberculous infection is of human or bovine origin, but also in judging of the relative importance to man of these two sources of infection. In this light the work which I report must be regarded as added testimony in favor of the value and reliability of the study of cultures of tubercle bacilli.

The milk examined must be considered a little below the average grade. Subsequent inquiry at the Board of Health revealed that of the 19 tuberculous specimens, 14 were sold by dealers who furnish bottled milk coming from the same farms (Table II). In some instances this bottled milk is commercially pasteurized, but, as we have shown, this process does not afford adequate protection. A circumstance which emphasized the reliability of my results was furnished by a chance control experiment. The samples of milk were in some instances selected at random from those sent to the laboratory by the inspectors. It so happened that of the 10 samples submitted on January 6th, 4 proved to be contaminated with tubercle bacilli (Table II). Recently on inquiring into the source of these samples I learned from the records that the 4 samples were taken from 2 cans in the same plant; in other words, that 2 were duplicates. This method of control specimens is resorted to by the Board of Health to compare the results of the bacterial counts. In this instance it served as an unconscious control of my work, and demonstrated its value. Again, on November 12th two positive specimens were obtained which emanated from the same wholesaler, although retailed by different stores in the same neighborhood. On December 5th this happened in three instances. This milk was supplied by some of the largest dealers in the city, and it seemed as if a considerable part of their supply was contaminated on these days.

In the test of the milk-supply of the city of Washington, reported this year by Anderson, 6.72 per cent. of the samples were found to contain tubercle bacilli.[1] This figure is considerably lower than that which I report for New York. This difference can be in part accounted for by the fact that in the Washington tests usually only one animal was used for each sample, and that the cream was not injected. Had the same procedure been followed by me, the number of positive results would have been decidedly fewer, as may be judged by the fact that of the 19 tuberculous specimens, only 9 produced tuberculosis in both of the injected animals. In 5 instances this was due to the death of one of the guinea-pigs. However, in 2 cases virulent tubercle bacilli were demonstrated in the sediment alone; in 3 others in

the cream alone; the animals injected with the negative portion of these samples developed no lesions or such lesions as were inconclusive. It is clear that, had I not injected the cream, 3 of the positive cases would have been reported as negative, which in itself would have reduced our figures from 16 to 13 per cent. Higher percentages than we obtained have been published by others. Rabinowitsch and Kempner found, in an examination of 25 samples of Berlin milk, that 7 samples, or 28 per cent., contained tubercle bacilli. In an examination by MacFadyean at the Jenner Institute, 17 among 77 specimens, or 22 per cent., were found to be infected with virulent tubercle bacilli.[5]

What importance is to be given to the fact that 16 per cent. of the general milk-supply of New York city is contaminated with virulent tubercle bacilli? The very size of these figures is proof that we all, young and old, must possess a considerable degree of immunity to the infection. For it is probable that few infants fed on the ordinary raw milk do not ingest tubercle bacilli during the first year of their lives; it is, I believe, more than probable that they do so repeatedly. Furthermore, we know that children are especially susceptible to tuberculous infection, and yet tuberculosis is by no means the main factor in the high death-rate of infancy. On the other hand, it is certain that the bovine bacillus is frequently, in childhood, the cause of tuberculosis of various organs: of the tonsil, of the cervical glands, and of the mesenteric glands. Among others, Theobald Smith, Fibiger and Jensen, the German and the British Commissions, and the writer have reported cases of this nature. Recently I was able to collect 44 cases of undoubted bovine infection of the mesenteric glands, 41 of which occurred in children. These figures are not sufficient to prove that bovine tuberculosis is the "great white plague" which we all are fighting, but they do show, without doubt, that this bacillus is fraught with danger to children. Even the stanchest supporter of Koch would not care to have his children drink milk from a cow which he knew was excreting tubercle bacilli. At present there seems to be insufficient basis for a statistical estimate of the importance of bovine tuberculosis, but we must remember that, even if we charge it with but 1 per cent. of the total tuberculous infections, this small percentage is sufficient to establish it as a disease worthy of active recognition. The total number of cases of tuberculosis, exclusive of duplicates, which were reported in Greater New York in 1907, was, according to Biggs, almost 20,000. Every one realizes that this figure is far below the actual number, and yet if we accept it, and if we consider only 1 per cent. of this yearly total to have been of bovine origin, we must attribute 200 of the reported cases to this cause. In view of the studies thus far carried out both here and abroad it would seem best, at the present time, to regard the bacillus of the human type as the cause of the great scourge, the scourge of tuberculosis, and to look upon the bovine bacillus as the cause of a definite but much less wide-spread type of disease.

Finally, the practical lesson which this investigation teaches is not new; it has been emphasized, with ever-increasing earnestness, by many of those here to-day. It is to be hoped, however, that the alarming degree of tuberculous contamination which I have found in the New York city milk, and the concrete figures which I have furnished, may prove an effective argument for those who are striving with the legislators in the cause of pure milk. It is unfortunate that it was not possible to trace the milk to its farm, and that I am unable to tell you of the physical condition of the cows or of the herds which supplied the milk; to state whether or not they were clinically free from tuberculosis. As I used mixed milk in my tests, it is possible that the bacilli which I found were, in some instances, given off by one infected cow and were diffused throughout the supply. No doubt this is true to a certain extent. However, we cannot well fall back upon this explanation when we reflect that a recent report by Moore showed that of 421 herds in New York State tested with tuberculin, 302 contained reacting animals. This high percentage of disease harmonizes with the high percentage of contamination which I found in the city milk. Again, the investigations of Schroeder, showing how frequently feces is present in milk, and how frequently tubercle bacilli are present in the feces of apparently healthy cattle, also point clearly to a wide-spread source of dairy infection. In view of these facts it would seem wise, as an immediate safeguard, to boil or thoroughly pasteurize all milk not coming from tuberculin-tested cows. At the same time those who are urging broader remedial measures, such as adequate inspection and supervision of the dairy herds, should be accorded the support of physicians and laymen alike. If New York city was granted, instead of 47 inspectors of farms, 150 such inspectors, it is certain that 16 per cent. of the milk sold in its precincts could not be found to harbor virulent tubercle bacilli.

TABLE I.—DATA OF MILK INOCULATIONS.

Date.	Number of Samples.	Animals Inoculated.	Died within Twenty-four Days.	Otherwise Lost.	Secondary Inoculat'ns.
October 24th	12	24	2	2	2
November 7th	12	24	..	..	6
" 12th	12	24	..	..	2
" 19th	12	24	..	..	4
" 25th	6	12	..	..	4
December 5th	12	24	1	..	6
" 19th	6	12	1	..	..
" 26th	6	12	1	1	..
" 31st	12	24	1	3	..
January 6th	10	20	4	3	2
February 5th	12	24	..	1	..
Total	112	224	10	10	26
Net total	107	(In five cases both animals were lost or died.)			

TABLE II.—DATA OF TUBERCULOUS MILK SPECIMENS.

Date.	Tuberculous Specimens.	Cream or Sediment.	Bacteria per c.c.	Wholesaler.	Wholesalers who Sell also Bottl'd Milk.
Oct. 24th....	1	Sediment *	390,000	A	0
Nov. 7th ...	1	Sediment	4,800,000	B	1
	1	Cream and sediment	80,000	C	1
Nov. 12th ...	1	Cream	170,000	W	1
	1	Cream and sediment	90,000	W	1
Nov. 19th ...	1	Cream and sediment	80,000	E	1
	1	Cream and sediment	..	B	1
Nov. 25th ...	0	..	..	..	..
Dec. 5th....	1	Sediment	50,000	O	0
	1	Cream	1,400,000	G	1
	1	Cream and sediment	20,000	B	1
	1	Cream	60,000	B	1
	1	Sediment*	..	B	1
Dec. 31st	1	Sediment*	..	E	1
	1	Cream and sediment	8,000,000	H	0
	1	Cream*	230,000	B	1
Jan. 6th.....	1	Cream and sediment	160,000	J	1
	1	Cream and sediment	180,000	J	1
	1	Cream*	60,000	J	1
	1	Cream and sediment	..	J	1
Feb. 5th.....	0	..	..	..	..
	19 (17,	excluding duplicates.)			

TABLE III.—DATA OF INTRAVENOUS INOCULATION OF RABBITS WITH PURE CULTURES OF TUBERCLE BACILLI.

	Total Age of Culture.	Number of Transfer.	Age of Culture.	Amount Inoculated.	Number of Rabbit.	Result.	Remarks.
Culture I.	82 days	3d	22 days	0.5 c.c.	320	Chlo'form 21 days (ill)	General tuberculosis.
Culture II.	95 days	4th	20 days	0.5 c.c.	321	Died 18 days	" "
Culture III.	76 days	3d	25 days	0.5 c.c.	325	Died 16 days	" "
Culture IV.	67 days	3d	28 days	0.4 c.c.	326	Died 20 days	" "
Culture V.	98 days	4th	21 days	0.5 c.c.	327	Died 23 days	" "
Culture VI.	79 days	3d	30 days	0.5 c.c.	331	Chlor.17 days	" "
Culture VII.	69 days	3d	26 days	0.5 c.c.	332	Died 15 days	" "

LITERATURE.

1. Anderson: Hygienic Laboratory Bulletin No. 41.
2. Ostertag: Untersuch. über die klinische u. bakt. Feststellung der Tuberk. des Rindes, 1905.
3. Hess: "Tuberculosis of the Tonsil," Archives of Pediatrics, August, 1907. "Tuberculosis of the Mesenteric Glands," Am. Journ. Med. Sci., August, 1908.
4. Rabinowitsch and Kempner: Zeitsch. Hyg., xxxi, 1899.
5. MacFadyean: Lancet, vol. ii, 1899.

* Animal inoculated with other part of milk lost or died.

Estudio del Contagio por la Leche en la Ciudad de New York.—(HESS.)

Para esta investigación se usó "leche suelta," es decir la leche que se detalla en cargas. En muchos casos esta es la misma que la embotellada. En cada prueba se emplearon diez centímetros cúbicos de leche. Esta se centrifugaba y como 1 c.c. de crema y la bajisma c.c. de leche era inoculada á un conejo de Indias, usandose en todas dos conejos para cada prueba. Las inoculaciones se hicieron intramusculares y subcutáneas. De 107 especimen probados de este modo, 17 ó el 16% presentó tuberculosis. Como la tuberculosis del ganado es comunicable al hombre, especialmente á los niños, esta condición del mercado de la leche es una amenaza á salud pública.

De ocho pruebas realizadas de manera semejante con "leche comercial pasteurizada uno contenía bacilo tuberculoso virulento. Este resultado demuestra que en la práctica la llamada comercial pasteurización no merece confianza por protección. Si la leche no proviene de vacas probadas por la tuberculina, debo ser suficientemente pasteurizada ó hervida.

Se aislaron de la leche algunas culturas de bacilo tuberculoso. En varios casos probó ser del tipo-bovino segun su morfología, manena de crecer y virulencia en los conejos. Este no uniformidad debe considerarse como una evidencia más de la constancia del bacilo tuberculoso bovino.

DISCUSSION.

DR. MAGILL (New York): I wish to mention some experiments of my own, which in the light of Dr. Hess' investigation open a subject for your earnest reflection.

Some years ago I made a similar examination of the milk-supply of Paris, and found the tubercular contamination to be about 12 per cent. of such milk. In 1901 I made a similar series of examinations of the milk of New York city, and found from 10 to 11 per cent. of such milk contaminated with tubercle bacilli. Both of these milk-supplies at the time of my examination were not subject to any special regulations to protect from tubercular contamination. For some years the Board of Health of New York City has very widely proclaimed its efficient system of inspection, tuberculin testing, and similar sanitary control measures, pretending that in this manner it was efficiently guaranteeing the public against tubercular contaminated milk. The Health Commissioner of New York City repeatedly proclaimed this to the Board of Aldermen at least two years ago, and this has been widely and repeatedly declared by him in the daily papers. Note that my results show 12 per cent. in Paris and 11 per cent. in New York of tubercular contaminated milk when no efforts for protecting this milk were in operation.

Now, after at least two years of this publicly proclaimed efficient control of the New York City Board of Health, Dr. Hess shows you 16 per cent. of

the milk of that city to be contaminated with tubercle bacilli. What is the explanation?

Dr. Moore: I am not in a position to answer that question. There is a large number of inspectors sent out by the State Board of Health for the purpose of inspecting the dairies. These inspectors, I understand, rarely apply the tuberculin test. There are also milk inspectors of the State Department of Agriculture looking after the milk, largely from the standpoint of purity and fraud. These men make no tests of the herds with tuberculin. There are also inspectors in the employ of the milk companies who are trying to produce a good milk-supply, and I think in these cases the inspectors are veterinarians and not simply dairymen, and that they pick out a greater number of diseased animals than do the others. I cannot agree with the last speaker that all the milk which goes to New York city is from tuberculin-tested animals. There is a certified milk sold in New York city and there are a great many herds which are tuberculin tested, but this is not the rule. An effort is being made, and the spirit is growing, among the dairymen of New York—they are beginning to realize that they cannot afford to have tuberculosis in their herds. Through these agencies much energy is being manifested toward improving the conditions. There are also many dairymen trying to carry out the Bang system. There seems to be a movement to better the conditions generally, and while we all are anxious to show results, the progress is slow; yet when we stop to look back for one, two, or three years we can see that much progress has been made.

At the conclusion of this discussion the Section adjourned till half-past two o'clock.

SECTION VII.

Tuberculosis in Animals and Its Relations to Man.—(*Continued.*)

SECOND SESSION.

Tuesday afternoon, September 29, 1908.

CONTINUING THE DISCUSSION OF PREVALENCE AND ECONOMICS OF TUBERCULOSIS IN ANIMALS.

The Section was called to order by the President, Dr. Leonard Pearson, at half-past two o'clock.

BOVINE TUBERCULOSIS IN LOUISIANA AND SOME OTHER SOUTHERN STATES.

By W. H. Dalrymple, M.R.C.V.S.,
Louisiana State University and Experiment Stations.

The prevalence and extent of bovine tuberculosis in the southern States of North America seem to depend largely upon the condition and environment under which cattle exist; and also upon the predominance, or otherwise, of the improved breeds. Hence the factor of introduction of the modern well-developed dairy breeds especially would seem to play an important part in the up-keep of infection in the dairy sections, as it is in the latter we seem to find the largest percentage of tuberculous animals.

True, the genial climate of the southern States, permitting an almost continuous outdoor existence throughout the entire year, should afford ideal conditions for the maximum of healthfulness in our cattle, and to a considerable extent this is no doubt the case. But, of itself, it is not sufficient, of course, to prevent, although it evidently tends to curtail, the spread of infection when once it is introduced.

In the autumn of 1888, while experimenting with improved breeds of cattle at the North Louisiana Experiment Station, situated in a pine-hill section of the State, a pair of Holsteins and a pair of Jerseys were purchased from breeders in a neighboring State. In 1891 a pair of Devons and also a pair of Guernseys were bought, the former in a contiguous State, the latter in one considerably further north, viz., South Carolina. The only losses prior to about 1895, since the inauguration of these cattle experiments, were the two Devons, which, at the time, were considered to have succumbed to tick fever; and the original Holstein cow, from age and general debility. No suspicion whatever of tuberculosis attached to any of the deaths mentioned, nor could any of the symptoms be recalled as similar to those exhibited by any of the animals which later developed the disease, and which were destroyed and subjected to post-mortem examination.

The increase from the above-mentioned purchases gave the Experiment Station in 1895 a sufficient number of milking cows to justify the establishment of a small dairy upon strictly scientific lines. Accordingly, a stable, or barn, and a dairy building were erected and equipped in the most approved (at the time) manner. The stable had a concrete floor, plenty of light, air-space, and ventilation, and with a wide alley-way between the two rows of stalls. In fact, this stable was perhaps more in keeping with modern hygienic and sanitary requirements than any other similar structure in the State.

During the entire year the cows were confined in this building only while being milked and fed, the remainder of their time being spent in the open air.

In the late summer of 1896 the condition of one of the Jerseys (a three-year-old) attracted the attention of the director by her gradual emaciation for several weeks previous to this time, and he at once suspected tuberculosis. An investigation was then made of the entire herd, numbering 22 animals, including 5 calves under one year old. The tuberculin test was employed, and 6 out of the 22 head responded, or almost 28 per cent. All of the reacting animals were ultimately destroyed, and the diagnosis was verified in each instance.

Although perhaps not quite germane to the topic under consideration, it might be of interest to note the effect of the tuberculin on some of the animals tested, as there is at present, it would seem, a good deal of discussion on this point:

The Jersey cow which first aroused suspicion, and which was the only one destroyed at the time, she being in a very much emaciated condition, had the same maximum temperature (103°) before as she had after injection with tuberculin, and yet on post-mortem was found to be bordering on the last stage of generalized tuberculosis, which frequently happens in advanced but apparent cases.

In the case of a three-year-old grade Jersey cow, which was within two months of calving, the rise of temperature after, above the average before injection, reached only nine-tenths of one degree, showing that the normal temperature was not appreciably disturbed by the administration of the tuberculin.

In the case of a seven-year-old Holstein cow, which was in estrum at the time of injection, the administration of the tuberculin did not seem to have any marked effect. In fact, the maximum temperature after (101.2°) was lower by eight-tenths of a degree.

There is quite a difference, also, in the time at which different animals show the highest temperature after injection with tuberculin:

A four-year-old Devon cow registered her highest temperature (105.4°) at the tenth hour after injection, and showed the same temperature at the twelfth hour.

A nine-year-old Jersey cow registered her maximum temperature (104°) at the twelfth hour; a five-year-old Jersey cow was highest at the fourteenth hour; a ten-year-old Holstein bull gave his maximum (105.1°) at the eighteenth hour; while a nine-year-old Jersey bull and a nine-year-old Guernsey cow registered, respectively, 103.6° and 104.4°, their maximum temperatures, at the nineteenth hour after injection. It might be stated that this Jersey bull's maximum, viz., 103.6°, may be considered low for a tuberculous animal, but his average before injection only reached 100.3°, which gave a reaction of 3.3°.

With the exception of the Jersey cow, which had generalized tuberculosis and was destroyed, not one of the rest of the reacting animals showed any physical evidences whatever of the disease. These cattle were isolated and again tested, and upon reacting a second time were destroyed, and a post-mortem examination made on each, with positive results.

In this way the diseased animals were ultimately got rid of, and the stable thoroughly disinfected. The latter was accomplished by the removal and destruction by fire of all inexpensive woodwork, such as mangers, etc. The entire inside of the building was then flushed with hot water to soften all old whitewash, some of which was much soiled with splashed ordure from the animals, and this was removed by means of scrapers, such as are used on shipboard, and trowels, until the woodwork had the appearance of new wood; and the concrete floor having undergone similar treatment, was left as clean as it was possible to make it. All of the detached refuse was subjected to thorough disinfection.

After a second complete flushing, and the woodwork, stalls, etc., allowed to dry, a disinfectant spray of bichlorid of mercury (1:500) was employed by means of a knapsack spray-pump to saturate everything within the building. After this had dried sufficiently, a final application of a mixture

of lime-wash and one of the commercial coal-tar products (5 per cent.) was made to the entire inside of the stable, and the latter was afterward left open to sunlight and air, and left unoccupied for a period of sixty days.

In the mean time the most of the remainder of the herd, which were sound, had been disposed of, and afterward some fresh purchases made, but since the reoccupancy of this previously infected stable, which is now at least ten years ago, a case of tuberculosis has not been suspected among the cattle of this particular experiment station.

Just how the disease originated in this herd it is difficult to say. It may, probably it must, have been introduced in some of the purchases mentioned. If so, however, it had remained in latent form for a considerable period of time, as there was at least an interval of five years between the last purchase of pure-bred animals from outside the State and the cow mentioned which aroused suspicion, and which was the first case of indisposition that had exhibited symptoms of tuberculosis.

Although, in this age of advancement in research work, opinions, to be worth anything, must be based upon accurate scientific data, it may be incidentally mentioned, as a point of interest and for what it is worth, that one of the employees on the experiment station had died of an acute attack of tuberculosis some time previous to the disease having been suspected in the dairy herd.

This man's special occupation did not lead him into direct contact with the cows, but his headquarters were within a few yards of the stable, and he spent a good deal of his unoccupied time with the dairymen and among the cows. We venture upon the interrogatory here, although we do so with "fear and trembling" before such an intelligent body—many for, some against, perhaps, the theory of intercommunicability: Could there possibly be any connection between the cases?—which, of course, opens up the question of the unity or duality of the tubercle bacillus. A positive statement in the particular case cited could not, of course, be made. No other cases of the disease in human beings, however, had previously been known among the employees of the experiment station.

The description of the outbreak in the experiment station herd, which I have gone into rather at length, goes to verify, in a measure, at least, what I have already stated, viz., that even our genial southern climate and outdoor conditions, and with more or less modern stable buildings and equipment, although they may be much more desirable than the conditions and environment found in colder latitudes, where animals have to spend so much of their time confined indoors; and are, or ought to be, more conducive to general healthfulness and vigor, cannot stay the ravages of the disease in the absence of supplementary methods of amelioration. But the outdoor life itself must of necessity be a most important factor in aiding physical resis-

tance on the part of the animal economy. On the other hand, the native or "scrub" cattle of the south, which are permitted to lead a more or less nomadic existence, are singularly free from tuberculosis. It is possible that the commercial dairy herds of the large southern cities, whose liberty is limited, in many instances, to filthy stables, and equally unsanitary yards, will show as high a percentage of infection as herds similarly situated, or even in country herds, in the colder or other sections of the country, which have enforced confinement during a considerable portion of the year.

Owing to other pressing duties and lack of sufficient time it has been difficult for me to obtain the amount of accurate data I should have liked on the subject of this paper, to present at this time. I was able, however, to secure a few straggling items, which I have tried to whip into shape, and that may be of interest.

The late assistant veterinarian of the Louisiana Experiment Stations, Dr. H. J. Milks, who had distributed to veterinarians throughout the southern States a list of questions on this particular subject in order to secure data for a report he was about to prepare as a member of the Committee on Diseases of the American Veterinary Medical Association, very kindly permitted me the use, although quite late in the day, of what replies he had received, but which I am rather afraid are somewhat inadequate and meager to afford a full conception of the conditions. However, I will endeavor to use them as best I can. The questions are as follows, with the exception of one relating to swine:

1. Is tuberculosis prevalent in your State?
2. What is the percentage in dairy cattle? Other cattle?
3. Does the percentage seem larger where cows are stabled than where they are allowed to run at large?
4. Is the tuberculin test employed in your State, and to what extent?
5. What percentage of stabled cows have reacted? What percentage of unstabled?
6. Is the Bang method followed in your State, and with what success?
7. Have you any State law with regard to testing cows for tuberculosis?
8. Is the disease on the increase or decrease in your State?
9. Have you a law requiring animals to be tested before coming into your State?

Approximate Summary of Replies.

Arizona:

Tuberculosis not prevalent, or only very slight.

The disease practically unknown among the native range cattle.

The climatic conditions prevent the necessity for stabling.

The tuberculin test has been employed in suspects, and is frequently used by the territorial veterinarian in examining cattle.

The Bang method is not employed.

There is no territorial law requiring animals to be tested with tuberculin, but an inspection or certificate is required of all dairy and breeding cattle entering the territory.

Arkansas:

Tuberculosis is not prevalent.

Few dairy herds have been tested.

The disease seems to be rare in native cattle.

The percentage is larger where cows are stabled.

The tuberculin test is employed in suspects, or by request.

Tuberculosis to the extent of 60 per cent. has been found among the dairy herds of some of the charitable institutions of the State.

The Bang method is not employed.

There is no special law for tuberculosis in the State.

Not sufficient evidence to warrant a statement as to increase or decrease of the disease.

Animals are not required to undergo the test before entering the State.

Florida:

Tuberculosis is prevalent in dairy cattle in the State, the southern portion showing 9 per cent.; the middle, 10 per cent.; 100 miles north of the middle portion, 15 per cent.; and the northern portion, 25 per cent. These figures do not represent an average, however, over the entire State, but only a small portion.

The disease is prevalent in other cattle, although range animals are an unknown quantity.

Cattle are not stabled at any season of the year.

The tuberculin test is employed, but is not compulsory, except in the case of dairy herds supplying some cities, such as Tampa, with milk, and which have local ordinances.

The percentages already mentioned were for stabled cattle. There are no data for unstabled animals.

The Bang method is not used.

There is no State law requiring the employment of the test.

One correspondent states that he thinks the disease is on the increase, as no means are being employed to prevent it; while a Tampa correspondent mentions a decrease in that particular section.

Animals are not required to be tested before entering the State.

Kentucky:

Tuberculosis is prevalent in the State.

Animals (88 head) supplying milk to Lexington showed 29.1 per cent. reactions. Those in the neighborhood of Louisville showed about 30 per cent., while those tested around Covington have shown but slightly lower than 23.4 per cent. reactions.

Fifty per cent. of a herd in Lexington reacted. No data as to other cattle.

Stabled cattle show the greater percentage of the disease.

The test is used in suspects, or by request.

The cows tested in the neighborhood of Lexington were out-of-doors day and night in good weather.

The Bang method is not employed.

There is no State law compelling the use of tuberculin.

The disease is believed to be on the increase.

There is no law requiring imported animals to be tested.

Louisiana:

The disease prevails among dairy cattle in Louisiana. The data, as to percentage, is insufficient for the whole State, but has been high in the city of New Orleans especially.

Native and range cattle appear comparatively free from infection.

The tuberculin test is required under a newly revised sanitary code of the State.

The Bang method is required by said code, but where found impracticable, communities may adopt a modification, permitting segregation of reacting cows, showing no physical evidences of tuberculosis, on separate farms, the milk and meat to be sold under sanitary regulations.

Recent live-stock sanitary legislation, conferring plenary powers on a State Commission, will no doubt eventually require the testing with tuberculin of all breeding and dairy animals before entering the State.

With no special effort hitherto made to control infection, outside of the city of New Orleans, and possibly one or two of the smaller municipalities having meat and milk inspection ordinances, it is probable that the disease may be on the increase.

Mississippi:

The disease is prevalent among dairy cattle, possibly from 2 to 7 per cent.

No data with regard to other cattle.

The percentage is larger in stabled cows.

The test is only employed by some towns requiring it.

The Bang method is not employed.

The tuberculin test is not made compulsory by State law.

The disease is on the increase.

(I might add here that Mississippi has a live-stock sanitary law similar

to Louisiana, which gives their live-stock sanitary board plenary power, but which has not, as yet, evidently been employed with regard to tuberculosis.)

New Mexico:

The disease is prevalent in the Territory.

Estimated percentage in dairy cattle, 10; in other cattle, 1 to 2.

The percentage is larger in stabled animals.

The tuberculin test is employed to some extent in the Territory.

The Bang method is not followed.

There is no law requiring the use of the tuberculin test, either in cattle within the Territory or in imported animals.

The disease is thought to be on the increase.

North Carolina:

The correspondents were not familiar with the average conditions for the entire State.

The prevalence of the disease, within a radius of 100 miles of Charlotte, is not great. The average percentage is given as four-fifths of 1 (0.8).

Animals are only stabled during milking periods, and in winter only during very severe weather. The open-air existence is considered the chief factor in keeping down the percentage of reactions in the dairy cattle.

Cattle are tested by the State veterinarian on request. In cities or towns having dairy inspection laws or ordinances testing is compulsory.

The Bang method is not employed.

The State has the authority to control tuberculous cattle, but there is no State law compelling the test, unless the owner requests it.

The correspondent cannot offer an opinion as to the increase or decrease of the disease in the State. It is believed there is a State law requiring imported cattle to be tested.

Tennessee:

Tuberculosis is prevalent in the State.

Dairy cattle affected, about 10 per cent.; other cattle, about 1 per cent.

The percentage is larger where cows are stabled: 15 per cent. reactions in stabled animals; 2 per cent. in unstabled.

Private testing is employed to a limited extent.

The Bang method is not followed.

There are no State or municipal laws on the subject of bovine tuberculosis.

The disease is on the increase.

Texas:

About 40 per cent. of the herds in the neighborhood of the larger cities are infected, but the average percentage is low.

Dairy cattle show about 1.8 per cent. infection; other cattle, almost "nil."

Cattle are stabled only during milking periods.

About 2500 head of dairy cattle have been tested within the past year.

The Bang method is not employed.

There is no specific law requiring the test, but if the State Live-stock Sanitary Commission suspects tuberculosis, they have sufficient authority to test the herd or herds.

The disease is on the increase.

There is no law requiring imported animals to be tested.

West Virginia:

The disease is not very prevalent.

The correspondent could not state the relative percentage of the disease in dairy and other cattle. It is stated to be larger, however, in stabled than in unstabled animals.

Herds are tested by the State Board of Agriculture upon request of the owners.

The Bang method is not employed.

When animals are suspected by the consulting State veterinarian in making his annual dairy inspections, they are required to be tested.

The disease is said to be on the decrease.

All imported animals for breeding purposes are required to be tested.

Reducing the gist of these replies down to its final analysis, the following, it seems to me, are about the most reasonable conclusions to be arrived at, and inferences drawn from them:

1. That bovine tuberculosis is prevalent, and apparently on the increase in the southern States heard from.

2. That this prevalence and increase are almost wholly among stabled or, inferentially, dairy cattle.

3. That the native or unstabled cattle chiefly are practically free from infection, which is probably largely due to their open-air existence and lesser exposure to infection, and, possibly, to their greater natural resistance.

4. That the tuberculin test should be more universally employed in the south, and be made compulsory, especially in commercial dairy herds.

5. That the Bang method is worthy of more extended use, when practicable, as shown by the modification of it practised at the North Louisiana Experiment Station, and in its entirety in other parts of the country and in other countries.

6. That the several southern States should have laws passed in order to be able to deal effectively with bovine tuberculosis, both in animals within, and those imported into, each State.

7. That bovine tuberculosis may be eradicated from a herd when intelligent measures are adopted, both in connection with the animals themselves, and with the thorough disinfection of premises, and other necessary sanitary procedure, as shown by the results obtained in the dairy herd of the experiment station mentioned.

In reporting upon the outbreak of tuberculosis twelve years ago in the experiment station herd, I appended the following statement and recommendations:

"That as tuberculosis, or consumption, in cattle has been proved to exist in Louisiana, we would urgently recommend that no pure-bred or high-grade cattle should be imported without first having them tested, or obtaining a guarantee that they had been tested at a recent date (prior to purchase) with tuberculin."

"We would further recommend that owners of dairy stock, and especially vendors of milk, should, for their own benefit, both pecuniary and otherwise, and for the sake of the public health, have their cows tested with tuberculin at regular intervals. To be able to satisfy the mind of the public that he was disposing of milk from tested cows only, would be the finest advertisement a man in the business could have. And, as a benefactor to his race, in preventing the transmission of this terrible disease to numberless human beings, especially children, he would be deserving, and would be the recipient, of inexpressible thankfulness and gratitude at the hands of the public." And I am still of the opinion that the foregoing, so far as it goes, is just as applicable to-day as it was over a decade ago.

Tuberculose bovine dans la Louisiane et dans quelques autres États du Sud.—(Dalrymple.)

La propagation et l'étendue de la tuberculose bovine dans les États du Sud de l'Amerique du Nord semblent dépendre principalement des conditions et de l'entourage de la vie que mènent les bestiaux et de la prédominance, en d'autres mots, des améliorations de la race. De ce fait on peut déduire que l'introduction de vaches laitières de bonne race jouerait un rôle important en prévenant l'infection des sections des vaches laitières puisque c'est parmi ces dernières qu' on trouve ordinairement, le plus grand pourcentage d'animaux tuberculeux. Vraiment, le climat merveilleux des États du Sud, qui permet aux bestiaux de vivre presque continuellement en plein air pendant toute l'année devrait offrir à notre bétail des conditions ideales pour le maximum de santé et jusqu, à un certain point, il n'y a aucun doute que ce ne soit le cas. Il n'est pas suffisant, naturellement, pour prévenir la propagation de l'infection quand une fois, celle-ci a fait son ap-

parition, bien qu'il soit évident que ces conditions favorables tendent à en diminuer l'étendue et à en enrayer la marche.

Au début de l'automne de 1896, un troupeau de vingt-deux animaux comprenant cinq veaux au-dessous d'un an, ont été traités par la tuberculine à la Station experimentale de la Louisiane du Nord, et six des vingt-deux ont réagi, ou presque vingt cinq pour cent. Ceux, chez lesquels la réaction s'est manifestée, ont été triés dernièrement et le diagnostic offert par le traitement a été vérifié pour chaque cas. Sauf une vache de Jersey, atteinte de tuberculose généralisée, qui a été détruite immédiatement après le traitement, pas un des autres animaux n'ont montré un signe quelconque de la maladie.

Après la destruction définitive de tous les animaux qui avaient réagi l'étable a été complétement nettoyée et désinfectée, elle est restée ouverte et inoccupée pendant soixante jours. Depuis à temps, soit une période dan moins dix ans, il ne c'est produit aucun cas suspect parmi le troupeau de l'établissement. Aucun animal n'avait été introduit pendant un laps de temps de cinq ans, précédant l'investigation.

Tandis que la maladie est très repandue et qu'elle s'accroît peut être même, parmi les vaches laitières des États du Sud, les animaux indigènes ou scrub, sont singulièrement épargnés par la maladie, ceci est dû, très probablement, à leur existence nomade et en plein air, ils sont de ce fait, moins exposés à la maladie et y opposent plus de resistance.

Des rapports de douze États du Sud démontrent:

1. Que la tuberculose bovine est trés repandue et apparemment en augmentation.

2. Que l'extension et l'accroissement se manifestent plus exclusivement parmi les vaches laitières vivant dans les étables.

3. Que le bétail indigène celui qui vit en plein air, sans étable, n'est presque jamais infesté.

4. Que presque tous les États qui envoient leurs rapports, n'ont aucune législation pour combattre effectivement la tuberculose.

5. Que la methode Bang n'est exigée que par un code sanitaire nouvellement révisé de la Louisiane.

6. Que la minorité de ces États requiert le traitement de la tuberculine dans l'élevage des bestiaux avant leur arrivée dans l'État.

7. Que la tuberculose bovine peut être extirpée d'un troupeau si des mesures intelligentes sont prises pour les animaux eux-mêmes et pour la désinfection compléte des étables et d'autres procédés sanitaires comme le prouvent les résultats obtenus par le troupeau de vaches laitières de l'Etablissement d'expérience de la Louisiane du Nord.

DISSEMINATION OF TUBERCULOSIS AMONG ANIMALS IN ALABAMA.

By C. A. Cary,

State Veterinarian, Secretary of State Live Stock Sanitary Board, Auburn, Ala.

The death-rate from tuberculosis for the colored people is from two to seven times that of any other race, and the death-rate for the white people from the same disease is high enough to indicate the prevalent existence of that serious disease. The question naturally arises: How about tuberculosis in animals? Extensive and accurate statistics are wanting; yet a few records may give a relative idea of how the disease is propagated in the South among domestic animals. Up to the present time conditions, as a rule, have favored the non-extension of tuberculosis among animals.

1. The number of scrub and beef cattle and hogs in the south is relatively small. With the exception of Texas, the Gulf and South Atlantic States do not produce sufficient beef cattle and hogs for home consumption. The small number of widely scattered animals materially aids in preventing the spread of tuberculosis.

2. Most of these animals live in the open pastures or ranges; many are never confined in sheds or barns. This also helps to prevent the extension of tuberculosis.

3. On account of the high death-rate from tick fever, importation of beef cattle has been very limited. Hence, tuberculosis has been imported only in a very few cases.

4. With the exception of dairy cattle, the contact of animals with man, especially with the negro, is not close. This would practically eliminate transmission of tuberculosis from the frequently infected colored man to cattle.

5. Hogs rarely or never follow beef cattle in pens or feed lots.

6. There are few creameries in Alabama, and most dairies sell whole milk. Hence, hogs are not often fed skim milk.

7. Dairy cattle are exceptions to the preceding reasons for the non-extension of tuberculosis.

(*a*) They are more numerous than beef cattle.

(*b*) They are housed part the time each day.

(*c*) They are more numerously imported than beef cattle.

(*d*) They are in close contact with the white man and the negro.

(*e*) Calves are fed whole or skim milk and often two or more suck an old cow or one that has a spoiled udder.

Tuberculin tests are made annually of all dairy cattle that supply commercial milk to the public in the cities of Birmingham, Montgomery, and Mobile. In Montgomery tuberculin tests have been made for ten years, and while a few cases of tuberculosis have been found at different times in a number of herds, only one herd was found to be seriously infected. Out of 200 dairy cattle in that herd, 10 reacted to tuberculin in one year. In Mobile, out of one herd of 56 dairy cattle, 28 reacted to the tuberculin test.

Of all the distinctly dairy cattle that have been tested in Alabama in the past twelve years, these two herds were the only ones that were extensively infected.

In 1908, 82 head of cattle were tested on a farm in the Tennessee Valley of north Alabama. These cattle were pure-bred Angus, grade Angus, Holsteins, Jerseys, and scrubs. They were kept most of the time in pastures and fed at times in sheds and barns. The following shows in detail the results of the tuberculin tests:

Number of grade Angus tested	68
Number of pure-bred Angus tested	7
Number of Holsteins tested	3
Number of scrubs and Jerseys tested	4
Total number tested	82

Number of grade Angus reacting to test	31
Number of grade giving suspicious reaction	4
Number of Jerseys reacting	2
Number of pure-bred Angus reacting	2 (young)
Number of pure-bred Angus giving suspicious reaction	1 (young)
Number of Holsteins reacting	2
Total giving positive and suspicious reactions	42

None of the mature pure-bred Angus cattle reacted. The way the cattle were handled helped spread the infection. Several calves were permitted to suck old diseased milch-cows.

The history of this herd indicates that the original infection came from a Holstein bull that was brought from another State nine years previous to this time the cattle were tested. The fact that nearly 50 per cent. of the herd became infected largely by consuming infected milk

indicated that this disease may be quite rapidly disseminated in a herd in the south when no attempt is made to regulate the use of milk from infected cows. It is a common practice on some farms and at some dairies to permit two or more calves to suck an old cow that has one or more spoiled udders.

In the absence of extensive data the following tentative conclusions concerning tuberculosis of animals in the South may be shown:

1. The wide ranges and outdoor life of cattle tend to eliminate the transmission of the infection by moist infected nasal discharges or by infected fecal materials. Hence, scrub and beef cattle are rarely infected by tuberculosis.

2. Beef cattle are not finished in feeding pens on corn and are therefore never followed by hogs. Hence, hogs are rarely infected by tuberculosis.

3. The most common mode of transmission of tuberculosis among cattle in the south is by feeding young cattle on infected milk.

4. Hogs are very rarely kept and fed at dairies in the south.

5. How great a factor the tuberculous colored man is in the transmission of tuberculosis to cattle and hogs has not been determined.

6. Large pastures, frequent rains alternating with dry winds and sunny days, disinfect pastures and ranges that may be occasionally infected with feces containing tubercle bacilli.

7. Infected cattle, except those for immediate slaughter, must be tested with tuberculin before they can be shipped into Alabama.

CONTROL OF TUBERCULOSIS IN DOMESTIC ANIMALS IN PENNSYLVANIA.

By Louis A. Klein, V.M.D.,
Harrisburg, Pa.

The methods now in use in Pennsylvania for the control of tuberculosis in domestic animals have been developed since 1896, when the State Live-stock Sanitary Board was organized. These methods may be classified as follows: (1) Examination and tuberculin test at the request of owners of herds suspected of infection with tuberculosis. (2) Assisting owners in disposing of cattle that have reacted to private tuberculin tests. (3) Compulsory notification by practising veterinarians of cases in cattle of advanced or generalized tuberculosis or tuberculosis of the udder of which they may obtain knowledge. (4) Quarantining cattle affected with advanced or generalized tuberculosis or tuberculosis of the udder, and rendering assistance in disposing of such cattle. (5) Inspection and tuberculin test of dairy cows and cattle for breeding purposes shipped into Pennsylvania from other States. (6) Indemnification of butchers and others for cattle slaughtered for food and condemned on account of tuberculosis. (7) Coöperation with local boards of health in the inspection of dairy herds and the quarantine and disposal of cattle showing physical signs of tuberculosis. (8) Inspection of animals slaughtered for food and control of the sanitation of slaughter-houses. (9) Laboratory work.

Vaccination of cattle against tuberculosis is also being carried out on a number of farms, but this method is not as yet being generally applied. Information regarding tuberculosis is sent out in letters, circulars, and bulletins, and effective instruction in this line is also given by means of public post-mortem examinations of reacting cattle.

Dr. Leonard Pearson is the author of these various methods, and, as State Veterinarian and Secretary of the State Live-stock Sanitary Board since its organization, he has had charge of their execution.

1. *Examination and Tuberculin Test of Suspected Herds.*—This work is at present conducted under practically the same plan that was recommended to the Board by Dr. Pearson at its organization meeting in January, 1896. Certain details have been modified and new features have been added from

time to time to meet conditions as they arose, but the basic principle remains the same. This is the voluntary coöperation of the herd-owners. Looking backward, it appears that the plan was merely made to fit in with the circumstances, but it must not be forgotten that these circumstances had to be anticipated, and that when the plan was adopted tuberculin had only been known for five years, and there were so many different methods in use in the various States and in foreign countries for controlling tuberculosis in animals that there was no standard to follow. The principle of voluntary coöperation was based upon the conclusion that since it was necessary for the owner to observe certain precautions to prevent the reintroduction of tuberculosis into the herd, to appraise and remove the infected cattle without assurance of this coöperation would convert the work into a form of gratuitous live-stock insurance. The soundness of this conclusion has been proved again and again during the past twelve years.

The form of application in use at the present time is quite similar to the one first adopted. It contains a contract obligating the owner to dispose of the diseased cattle under the rules of the State Live-stock Sanitary Board; to thoroughly disinfect the premises and to correct any faulty sanitary conditions after the infected cattle are removed; to observe the precautions and employ the means recommended by the Board to prevent the reintroduction of the disease into the herd; to purchase for addition to the herd only such cows as have passed the tuberculin test, and if 20 per cent. of the herd reacts, to have a retest made at his own expense within eight months after the State inspection.

During the second year of the work applications became so numerous that it was not possible to make all the examinations requested, a condition that continues to this day; and since that time owners have also been required to state their reasons for believing that their herds are infected with tuberculosis, and an attempt has been made to examine those herds which appear most likely to be diseased. Not very long after the inauguration of the work applications had increased to four times the number of herd inspections that could be made with the money available, and numerous herds were being tested with tuberculin at owners' expense, a thing that was very rarely done before the State inspections were instituted. Applications for herd inspections have continued up to this time to be greatly in excess of the number of inspections that can be made. At no time since the beginning of this work have the resources of the State Live-stock Sanitary Board been sufficient to meet the demands of those who desired to coöperate with the State in the repression of tuberculosis in their herds.

The great increase in the number of applications is to be explained by the increase in knowledge of herd-owners and the general public regarding tuberculosis in cattle, and it is believed that no one thing did more to convince

cattle-owners of the economic reasons for repressing the disease in cattle than the policy of the State Live-stock Sanitary Board in arranging for them to witness post-mortem examinations of reacting cattle. When reacting cattle are to be destroyed on a farm, the farmers of the vicinity are afforded an opportunity to witness the post-mortem examinations, unless, as happens in some rare cases, the owner desires to avoid publicity, and it has been repeatedly observed that whenever cattle are disposed of under these conditions, a number of applications for herd inspections are received from the locality. In some cases when owners of infected herds have had no personal desire to apply for inspection, they have been led to do so by the public sentiment existing in their community or among the consumers of the products of the herd. Badly infected herds, when owners are uninterested, are usually brought to the attention of the Board by the operation of the law requiring notification of cases of advanced or generalized tuberculosis or tuberculosis of the udder, by neighbors or by local authorities.

When it is decided to make an inspection and tuberculin test of a herd, the work is assigned to a veterinarian practising in the locality, and a careful physical examination of each animal is made before the tuberculin test is applied. The tuberculin used in these tests is prepared in the laboratory of the Board. An examination is also made into the sanitary conditions of the premises and the herd hygiene. All cattle found to be tuberculous must be at once separated from the healthy animals, fed and cared for separately, and their milk not used for any purpose unless sterilized by boiling or pasteurized by heating for ten minutes at 165° F., until they are disposed of in accordance with the rules of the Board.

The owner has the choice of two methods of disposing of the tuberculous cattle: those not showing physical symptoms can be kept in quarantine under the Bang system, or all of the tuberculous cattle can be slaughtered. Professor Bang's method of repressing tuberculosis has not proved very popular in Pennsylvania. It has been adopted in only a very few instances. The reasons appear to be the restricted market for the heated milk and the extra work involved in maintaining two separate herds. When the owner elects to have the cattle slaughtered, they are appraised by an agent of the Board and the owner; but if no agreement can be reached by these two, which rarely happens, a board of appraisers is appointed: one by the owner, one by the State Live-stock Sanitary Board, and a third by these two. The law under which such cattle are appraised provides that not more than three-fourths of the actual value of the animal at the time of the appraisement can be allowed, and in no case can the amount exceed $25 for a grade or $50 for a registered animal. The appraisements for individual animals average from $22.25 to $23. After appraisement the cattle showing external symptoms of tuberculosis are destroyed, and the carcasses disposed of by burial

or cremation on the premises or through an approved fertilizer plant; the others are removed to a slaughter-house and killed under inspection, the carcasses being disposed of in accordance with the recognized principles of meat inspection. This latter practice is sometimes attended with difficulty in small towns, where butchers occasionally find it inadvisable to handle reacting cattle on account of the sentiment existing among their customers. Some meat consumers are very inconsistent in this respect. A butcher can buy a cow out of a herd, in the same locality, which is very likely in the same condition as the inspected herd, and slaughter it without inspection, and can sell the meat without objection; but if he buys cattle which have reacted to the tuberculin test, but which do not show any other symptoms of disease, and slaughters them under proper inspection, he may not only be unable to sell the meat, but may also gain the reputation of killing diseased animals. It is very gratifying to be able to state, however, that this inconsistency does not exist to the same extent that it did several years ago, and that it is fast diappearing as the knowledge of meat inspection and tuberculosis becomes more and more general.

After the tuberculous cattle are disposed of, the premises are thoroughly cleaned and disinfected under State supervision, and the owner is instructed with regard to the correction of any faulty sanitary conditions which may exist and the precautions to be observed to prevent the reintroduction of the disease into the herd. If more than 20 per cent. of the herd have reacted, a record is made of this fact, and the matter is followed up to see that a retest is made within the proper time.

Detailed statistics concerning this work for the last twelve years could be given, but they would only show the number of herds which it has been possible to examine with the resources at the command of the Board, and would furnish no exact information regarding the real value of this work to the live-stock interests of the commonwealth of Pennsylvania. However, in order to give an approximate idea of the cost of herd inspections I will append a few figures covering the last three years:

	Number Herds Inspected.	Number Infected Cattle.	Total Appraisement.	Expense of Inspection.
1905	773	1,352	$24,915.90	$4,589.59
1906	858	1.536	23,344.06	3,886.92
1907	878	1,819	20,232.40	3,670.59

The number of infected cattle given above does not indicate the extent to which tuberculosis exists in individual herds in Pennsylvania. These figures include the clinical cases disposed of during the year, and also those condemned in slaughter-houses on account of tuberculosis and for which

indemnity was paid. It must also be remembered that only the herds which were manifestly diseased were inspected and tested with tuberculin.

2. *Assisting Owners in Disposing of Cattle Found Tubercular on Private Examination and Test.*—Soon after the beginning of this work, herd-owners became so interested in repressing tuberculosis that when the Board could not comply with their application for an examination and tuberculin test, many of them had the examination and test made at their own expense. As early as 1897 a number of large herd-owners and dealers had arranged to sell cattle subject to the tuberculin test. These facts are cited to show the effect of the dissemination among cattle-owners of knowledge regarding tuberculosis.

In 1897, the second year after the inauguration of the work, it was decided to extend to owners having their cattle examined and tuberculin-tested at their own expense the same assistance in disposing of tubercular cattle as was extended in those cases where the examination and test were made by the State, and under the same conditions. This was done in order to extend assistance in repressing the disease to as many herd-owners as possible, and also to discourage unscrupulous persons from disposing of reacting cattle to unsuspecting purchasers. So many private tests were made that the demands for this assistance soon became so numerous as to overtax the resources of the Board, and at the present time a large number of herds are being examined and the tuberculous cattle disposed of in this way.

3. *Compulsory Notification of Clinical Cases.*—Since 1905 practitioners of veterinary medicine have been required by law to report to the State Livestock Sanitary Board all cases of advanced or generalized tuberculosis or tuberculosis of the udder of which they may obtain knowledge. Upon receipt of such a report authority is issued to an agent of the Board to appraise the affected animal, and if the owner will agree to the appraisement and will sign the contract described above, to have it destroyed and the carcass properly disposed of. The premises are then cleaned and disinfected and any faulty sanitary conditions corrected. If the owner refuses to dispose of the animal under these conditions, it is placed in quarantine and the use of the milk forbidden unless it is sterilized or properly pasteurized. Such refusal on the part of the owner, however, is very rare, because in most instances the case is brought to the attention of the veterinarian by the owner himself.

4. *Quarantine of Advanced Cases and of Cows with Tuberculous Udders.*—Cattle affected with advanced or generalized tuberculosis or with tuberculosis of the udder are a far greater menace to the herd and to the public than those animals in which the existence of the disease can be detected only by the tuberculin test, and for this reason every effort is made to locate such cattle and to reduce or abolish the dangers resulting from their existence. As already stated, many such animals are reported to the Board by veteri-

narians, but perhaps an equal number are reported directly by the owners. In some instances the reports come from neighbors or from local health officials. Frequently, reports from the latter sources are discovered to be unfounded, but a sufficient number of dangerously diseased cattle are found to justify an investigation of all such reports. The detection and quarantine or destruction of such animals not only remove fruitful sources of infection from individual herds, but also prevent the use of the milk of such cattle except under proper conditions, and make it impossible for them to be sold into other herds or to be slaughtered for beef.

5. *Inspection of Cattle Imported from Other States.*—At the beginning of this work it was recognized that the plans for the repression of tuberculosis within the State would be more or less vitiated if cattle were permitted to be shipped into the State without any regard to their condition as to health. Tuberculosis had been found to be most prevalent in the old dairy districts of the State which obtained their supply of cattle from outside sources. Counties in the interior of the State which raised a sufficient number of cattle to meet local demands, or in excess of this demand, and into which cattle from outside the State were rarely, if ever, shipped, were comparatively free from the disease. Several of the New England States had laws requiring that the tuberculin test be applied to cattle shipped from other States, and there was every reason to believe that cattle which did not pass the test would be sent into those States having no requirements. There was also positive knowledge of herds in other States being secretly tested and dispersed on account of extensive tubercular infection, the cattle being sold to dealers to be shipped a comfortable distance and sold to unsuspecting parties. A number of such shipments were made into Pennsylvania. With the State paying an indemnity for tuberculous cattle, there was also the possibility of cattle known to be diseased being purchased for a small sum in other States and shipped into Pennsylvania to obtain this indemnity. Cattle-dealers from other States had repeatedly tried to purchase reacting cattle from farmers in Pennsylvania, and it was not unreasonable to suspect that the same thing would be attempted in other States, and that if the farmer was not allowed an indemnity by his State, the sale was more likely to be made. Moreover, tuberculosis had been officially reported in all of the States from which cattle were being shipped into Pennsylvania, and in some of them it was quite prevalent.

Consequently a law was passed by the legislature in 1897, and became effective on January 1, 1898, regulating the shipment of dairy cows and cattle for breeding purposes from other States into Pennsylvania. Under this law the cattle are required to be inspected and tested with tuberculin either before shipment, at suitable stock-yards nearest the State line on the railroad over which they are shipped, or after their arrival

at destination. If the cattle are inspected outside of Pennsylvania, the law requires that the inspection must be made by an inspector who has been certified to be competent and reliable by the official in charge of the live-stock sanitary work in his State; if the inspection is made within the State, it must be made by an inspector approved by the State Live-stock Sanitary Board. If it is desired to have the cattle inspected after their arrival at destination, a permit to make the shipment must first be obtained from the Board. These permits authorize the cattle to be shipped in quarantine, and it is required that after their arrival at destination they shall be kept separate and apart from other cattle, that the milk shall not be sold or used without previous sterilization by boiling, and that they shall remain in the custody of the shipper until they have been examined and tested with tuberculin and pronounced to be free from disease by an approved inspector. These inspections are made at the expense of the owner, but the tuberculin is supplied by the Board. Tags, which are lettered and numbered serially, are also supplied for marking cattle which pass inspection. The inspector is required to give a full report of the tuberculin test, the conditions under which it was made, the physical condition of the animals, and the letter and number of the tag attached to each animal in his certificate, and he must also make affidavit to the statements. Any cattle found to be tuberculous are placed in quarantine and, if the owner wishes, can be slaughtered for beef under inspection. Formerly, upon application of the owner, a permit was issued to ship such animals back to the point of origin, and notice was given of the shipment to the live-stock sanitary authorities of the State whence they came, but since last November, when the Secretary of the United States Department of Agriculture issued an order forbidding the interstate movement of cattle and swine affected with tuberculosis, no such permits have been issued. Animals giving an indefinite reaction are placed in quarantine for a retest, which is usually made at the end of three weeks.

Since this law went into operation herd-owners applying for tuberculin tests, or for assistance in disposing of cattle which have reacted to a private test, have been required to certify that there are no animals in the herd which have been brought into Pennsylvania from another State without inspection and tuberculin test since January, 1898.

This law has been found to work quite satisfactorily. It has met with little opposition from shippers, and it has caused dealers to use all possible care in purchasing cattle for shipment into the State. Since it has been in operation cattle have not been purchased in such large numbers as formerly in those districts where tuberculosis is most prevalent; but while shipments from these districts have decreased, there has been a relative increase in shipments from other localities, so that there has been no effect on the total

number of shipments. Tagged cows have come to have a distinct market advantage in many sections of the State. In one shipment of 20 head from a neighboring State inspected last week 11 cows reacted. It is a common custom for milk-cows to be shipped into Pennsylvania in car-load lots and sold at public sale to individual buyers. The damage resulting from infected animals in such shipments would therefore be more wide-spread than if all the cattle went into one herd.

The lack of official supervision of inspections made outside of Pennsylvania has led to some unsatisfactory results. Some control over these inspections is given to the Board by the provision requiring that the inspector must obtain a certificate as to his competency and reliability from the live-stock sanitary authorities of the State from which the cattle are shipped. This affords protection from incompetent and untrustworthy men when proper care is exercised in issuing such certificates. But even a capable and conscientious veterinarian, employed by a man who is perhaps one of his regular clients, to examine and tuberculin-test cattle to be shipped to a stranger in another State, is not unlikely to look at the proceedings from the standpoint of the seller, and to decide in his favor any doubts regarding the condition of the cattle. It would be much more satisfactory could these inspections be made by inspectors appointed by the live-stock sanitary authorities of the State, and who had been given to understand that their continued employment in such work was entirely contingent upon the inspection being carefully and properly made. The expense of such a system of inspection would be exceedingly slight compared with the benefits resulting to those States producing cattle in excess of their needs. It would attract buyers from other States and would thus be a distinct advantage to herd-owners with cattle to sell; it would also afford the live-stock sanitary authorities a means of obtaining information concerning the location and extent of tuberculous infection, and, most important of all, it would insure a proper disposition of reacting cattle. Under the present conditions we have no knowledge or control over the cattle that react to the tests made outside of the State.

6. *Indemnification for Cattle Condemned as Unsuitable for Food on Account of Tuberculosis.*—Considerable assistance in the control of tuberculosis is afforded by a law passed by the legislature in 1903, which authorizes the payment of an indemnity to butchers, or others, for cattle slaughtered for beef and found to be unsuitable for food on account of tuberculosis. The effect of this law is to encourage the removal of suspected animals from a herd, and their slaughter for beef under proper inspection rather than their sale to another herd-owner; furthermore, it encourages butchers to request inspection of diseased carcasses and prevents diseased meat from going into the market. Sausage in various forms is extensively manufactured by the small butchers in Pennsylvania, and cows find a ready sale for this reason.

Before any indemnity is paid for condemned carcasses under this law, the butcher, or the owner of the animal at the time of slaughter, is required to submit a statement of claim containing a certificate of inspection, condemnation, and valuation signed by the inspector, and a statement showing that the animal has been continuously in the State for at least four months previous to the time of slaughter. All statements regarding ownership must be sworn to and the butcher or the last owner must also state the amount paid for the animal. The amount of the appraisement in such cases cannot exceed five cents per pound nor more than $25 for a carcass.

7. *Dairy Inspection.*—The inspection of dairy herds in coöperation with local boards of health affords another means of discovering cattle in which the disease is manifested by physical signs, and enables the Board to arrange for the proper disposal of these dangerous cases. The use of the milk from such cattle without sterilization or pasteurization is also prohibited.

8. *Inspection of Animals Slaughtered for Food and Control of Slaughter-house Sanitation.*—The State Meat Hygiene Service, while designed primarily to insure a wholesome meat-supply, also assists in the control of tuberculosis in animals, as well as of other diseases, by causing diseased carcasses and organs to be rendered or destroyed. In the course of this work it has been discovered that the feeding of tuberculous flesh and organs in the raw state to swine has been a prolific source of tuberculosis in these animals. In one lot of 48 hogs which had been fed on offal and other slaughter-house refuse in the raw state, 9 died, and when the other 39 were slaughtered under inspection it was found that all but one were affected with tuberculosis, and in 16 the disease was extensive and generalized. The custom followed in forbidding the use of milk from cows found to be tuberculous unless it is pasteurized or sterilized has also assisted in preventing the dissemination of the infection among swine as well as calves.

9. *Laboratory Work.*—The preparation of the tuberculin used in this work in the laboratory of the Board has not only supplied a tuberculin of known strength, but has also made it possible for the Board to supply tuberculin free of charge to practising veterinarians for testing cattle at owners' expense, and has afforded an opportunity for the supervision of the disposition of cattle reacting to such tests. This laboratory has also further assisted in this work by providing facilities for the investigation of various questions connected with the biology of the tubercle bacillus, the channels of infection, the relation of bovine tuberculosis to human tuberculosis, and other scientific problems of practical importance in the control of the disease. It also furnishes facilities for testing other tuberculins, the preparation of vaccine, etc. Indirectly the laboratory has also been of great benefit in obtaining for the Board the support and confidence of the public in general by its general scientific investigations, while it has gained the support and approval

of veterinarians by placing its facilities at their command in the diagnosis of obscure cases of disease.

It should not be concluded, from the efforts made in Pennsylvania to control tuberculosis in cattle, that the disease was more prevalent in this State at the time this work was instituted than in other States with large dairy districts and receiving their supply of cows from other localities. As has been stated, portions of the State where cattle were raised in sufficient numbers to meet local needs and into which few cattle were shipped were entirely free from the disease.

There are no statistics available to show the number of tuberculous cattle in the State when this work was begun, nor do we know the exact number of tubercular cattle in the State at this time. Consequently, it is not possible to tell by comparison exactly what has been accomplished. But slaughter-house inspections, observations by veterinarians on herds within the circle of their practice, and information from herd-owners and cattle-dealers furnish strong circumstantial evidence that the number of infected herds in Pennsylvania has been considerably reduced and that the prevalence of tuberculosis in infected herds has been still more diminished.

BOVINE TUBERCULOSIS UNDER RANGE CONDITIONS.

By M. E. Knowles, D.V.S.,

State Veterinarian, Helena, Mont.

During the past sixteen years, constantly seeing thousands of range cattle, under all conditions, winter and summer, although constantly looking for it, I have been unable to find one single animal showing, under strict range conditions, clinical evidence of tuberculosis, and the Federal abattoir reports show an infinitesimal number of range cattle with lesions on autopsy.

Cattle in Montana are "run" under three systems: absolute, or strict open range; partial range and partial pasture, with shed feeding during winter, and close domestication, where the cattle are always under fence and shed or stable.

Under both of the last named we find occasional centers of infection, with usually a small per cent. of affected animals, the number affected being dependent upon local conditions, usually under semi-range conditions; the cattle being fed during the winter months in corrals, with sheds for shelter, where there is abundance of shed room, with protection on three sides only. Under this arrangement the number of affected animals in a herd (ordinarily consisting of from 300 to 1000 cattle) will be relatively small—5 or 6 per cent.; but where the shelter provided is inclosed on all sides, although the cattle are fed in an open lot or corral, only using the sheds during the night and in stormy weather, the percentage of infection is usually large—in fact, nearly as great as though under close domestication and indifferent sanitation.

The ordinary cattle-shed in our western country is cleaned but once yearly, and has no designed ventilation provided, the cracks and openings dependent upon indifferent construction being regarded as sufficient ventilation.

Although it is rare, indeed, to see a closely built cattle-shed in the west, to the casual observer the loosely constructed one having large cracks,

knot-holes, and an occasional board off would seem to possess sufficient ventilation. When such sheds are closely packed with cattle at night or during stormy weather, the atmosphere within them is vile, thick, and moist, and in the coldest weather the cattle will be covered with moisture condensed from vitiated respiration.

Thus do a large number of infections occur among so-called range cattle; but how different are these conditions from those of strictly range animals, where, from the time they are turned out on the open range until they are rounded up for shipment to the shambles, they never see the inside of a building and rarely even a structure of any sort, other than nature provides.

My observation justifies the assertion that tuberculosis of cattle cannot exist under open range conditions, strictly speaking, especially in a high dry altitude, such as we have in Montana, where sunshine, the greatest of bacteria destroyers, is more abundant than it is in Egypt.

It is possible at low altitudes, subject to greater precipitation, profuse vegetation, and shade-providing foliage, that tuberculosis, being introduced, might persist and perpetuate itself. But even under these conditions, range sanitation nature provides is so salubrious, and conditions are so different from those of semi- or close domestication, so unpromising of filthy conditions, that the disease could not possibly make serious progress.

During the two years, 1903-04, that Montana's Meat and Milk Inspection Law was enforced, the dairy cattle of each county were tuberculin tested. Four of these have, during years past, drawn heavily on eastern States for dairy cattle, all the others obtaining their dairy herds from range cattle. Not a single cow reacted in these counties, while those with eastern dairy cattle constituting the majority of the herds, or having been the foundation of them, gave from 18 to 30 per cent. of reactions.

What better proof could be offered of the freedom of range cattle from tuberculosis? And what better supportive evidence of the wisdom of the modern treatment of tuberculosis in man could be adduced than the evident freedom from this disease of animals living under perfectly natural conditions?

Tuberkulose unter halbwildem Herdenvieh.—(Knowles.)

Während der verflossenen 16 Jahre habe ich fortwährend Tausende von halbwildem Vieh, unter allen Bedingungen, Winters und Sommers, gesehen, und obwohl ständig darnach suchend, war ich nicht im Stande auch nur ein einziges Tier zu finden, welches, streng im Freien gehalten, klinische

Zeichen von Tuberkulose geboten hatte; und die Bundesberichte der Schlachthäuser zeigen eine ausserordentlich kleine Zahl von halbwildem Vieh mit Verletzungen bei der Autopsie. Das Rindvieh in Montana wird nach drei Systemen aufgezogen. Absolut oder durchgehend im Freien, teils im Freien und teils auf der Weide, mit Schuppenfütterung während des Winters, und ausgesprochene Hauszucht, wo das Rindvieh fortwährend innerhalb des Zaunes, in Schuppen oder Stall ist.

Unter den beiden letztgenannten finden wir mitunter Infektionsherde mit für gewöhnlich nur einem kleinen Prozentsatze befallener Tiere, deren Anzahl von örtlichen Bedingungen abhängt; für gewöhnlich, wenn das Vieh teilweise im Freien untergebracht ist. Das Vieh wird während des Winters in Corralen gefüttert, in Schuppen zum Schutze gegen das Wetter, die genügend Raum bieten, und nur nach drei Seiten hin geschützt sind. Bei dieser Anordnung wird die Anzahl befallener Tiere in einer Herde (eine Herde besteht aus 300 bis 1000 Stück) relativ klein—5 oder 6 Prozent—sein. Wo aber an drei Seiten geschützte Schuppen vorgesehen sind, wird, selbst wenn das Vieh daselbst während der Nacht und in stürmischem Wetter sich aufhält, der Prozentsatz der Infektion für gewöhnlich grösser sein; tatsächlich beinahe so gross als unter enger Hauszucht und ungenügenden sanitären Bedingungen.

Der gewöhnliche Viehschuppen in unserem Westen wird nur einmal im Jahre gereinigt, und hat keine richtige Ventilation vorgesehen, da die Fenster und Türen ungenügend konstruirt, als genügende Ventilation angesehen werden, obwohl es wirklich selten vorkommt, dass man einen anständig gebauten Rinderschuppen sieht, und dem zufälligen Beobachter der locker zusammengefügte, grosse Spalten und Astlöcher habende, dem auch hier und da ein Brett fehlt, als mit genügender Ventilation versehen erscheint. Wenn solche Schuppen während der Nacht oder stürmischen Wetters mit Vieh voll gestopft sind, ist die Luft darin ungesund, dick und feucht, und im kältesten Wetter wird das Vieh mit einem durch die verdorbene Respiration hervorgerufenen Feuchtigkeitsniederschlage bedeckt sein—daher kommt eine grosse Anzahl von Infektionen unter dieserart aufgezogenem Vieh vor. Wie anders aber verhalten sich diese Bedingungen zu jenen, unter welchen das wildaufwachsende Vieh von der Zeit an, da es auf die Weide getrieben wurde, bis es zur Verfrachtung nach der Schlachtbank kommt, nie die Innenseite eines Gebäudes und überhaupt eines Gebildes von Menschenhand gesehen hat. Meine Beobachtungen rechtfertigen die Behauptung, dass Rindertuberkulose nicht existieren kann, wenn das Vieh halbwild aufwächst, genau gesprochen besonders in einer trockenen Höhenlage, wie wir sie in Montana haben, wo mehr Sonnenschein als grösster Bakterienzerstörer in Überfluss vorhanden ist, mehr als in Egypten. Es ist möglich, dass in Niederungen die grösseren Niederschläge, dichtere

Vegetation und die Anwesenheit von vielschattigen Bäumen eher die Möglichkeit tuberkulöser Verbreitung und eines Bestehens der Krankheit zur Folge hat. Aber selbst unter diesen Bedingungen sind die entgegenwirkenden Kräfte der Natur so ausserordentlich wirksam und verschieden von den Bedingungen der Stallaufzucht, dass die Krankheit keinen ernstlichen möglichen Fortschritt machen kann.

Während der zwei Jahre 1903 und 1904, in denen das Fleisch- und Milchbeschau-Gesetz in Montana strengstens durchgeführt war, wurden die Viehherden jeder Grafschaft mit Tuberkulin untersucht. Vier von diesen haben während der verflossenen Jahre ihr Vieh hauptsächlich aus östlichen Staaten bezogen, während die anderen ihre Herden aus halbwildem Vieh erhalten haben. In diesen Grafschaften reagierte nicht eine einzige Kuh, während jene, in welchen Vieh aus dem Osten den grössten Teil oder den Grundstock bildete, 18 bis 30 Prozent Reaktionen zeigten.

Welcher bessere Beweis könnte für das Freisein des wildaufwachsenden Viehs von Tuberkulose gegeben werden? und welche bessere unterstützende Kenntnis in der Behandlung der menschlichen Tuberkulose könnte von der Tatsache abgeleitet werden, dass Tiere, die unter strengstens natürlichen Bedingungen leben, von dieser Krankheit verschont sind?

TUBERCULOSIS IN RANGE CATTLE IN CALIFORNIA.

By George S. Baker,
San Francisco, Cal.

The impression is very wide-spread that an active outdoor life will not only prevent, but cure, tuberculosis both in the human and the bovine. This is true only so far as there is freedom from infection. The amount of tuberculosis in range cattle reaching the abattoirs at this point proves conclusively that outdoor life alone is not sufficient to either prevent or bring about a cure.

My attention was first directed to this in 1900, when in conducting post-mortem examinations of a bunch of steers I found 0.9 of 1 per cent. showing tubercular lesion. Careful records were kept of this range—hereafter known as Range 1—till April 18, 1906, when, unfortunately, they were destroyed by the fire, but these records showed a constant increase in tuberculosis, until at the end of 1905 we were getting over 9 per cent. tubercular.

From April 18th to the end of 1906 there were killed, from Range 1, 1844 cattle (bulls, steers, and cows), with 203 tubercular.

In 1907—from Range 1—1288 steers, 62 showing lesions of tuberculosis. From other ranges in the State, 5382 cattle of all kinds, with 181 tubercular. From Nevada ranges, 433 cattle, 13 tubercular.

In 1908, January 1st to June 30th—from Range 1—1153 cattle, 60 showing tuberculosis. From other ranges in this State, 26,330 cattle, 1121 tubercular.

From ranges of other States, 10,159 cattle, 33 tubercular.

It is safe to say that practically none of these cattle ever saw the inside of a barn, for while the practice prevails in this State, to a considerable extent, of annually restocking the ranges with dairy calves, very few of these calves are dropped in stables, but live out of doors from the beginning. This is, however, by no means the only source of supply; thoroughbred bulls are frequently introduced from breeding farms. These bulls, if kept till eight years of age or longer, are almost invariably consigned to the rendering tank on account of generalized tuberculosis, when slaughtered. This condition of bulls is not confined to Range 1, but is true of nearly all the aged bulls killed, and especially so of thoroughbred animals, grades being more frequently free from disease.

Range 1 is large, well watered, and divided between rolling prairie and mountain; a small proportion is low.

While the lesions of tuberculosis found in range steers are frequently slight, calcified, and confined largely to the cervical region, it is not at all uncommon to find steers two to four years old with well-defined, progressive cases, indicating virulent types of tuberculosis which point to recent infection. In many cases it is impossible to locate the primary focus, the lesions all being, apparently, about the same age; yet a wider dissemination, and a more active stage, are noticeable from year to year, while the proportion of generalized cases to the whole number affected is increasing all the time.

Where do these active, vigorous steers get the contagium? Certainly not from the young calves just received from the dairy, for they are kept separate. True, some of these steers undoubtedly were originally dairy calves, and brought the infection with them to the range, but in these cases the primary focus would be calcified and encapsulated, or there would be a cachexia, indicating a long-continued struggle against the disease, while what we frequently find, where it is necessary to condemn for generalization, is an acute progressive tuberculosis, which points clearly to recent infection.

A very considerable difference in the number of cases of tuberculosis is noticeable between 1906 and 1907 from Range 1; this is due to an effort in 1906 to rid the range of the disease. How unsuccessful this effort was is shown by the figures for 1907–08.

If it is true that the bovine is not susceptible to tuberculosis; that only the strongest, most virulent type of organism can induce the disease, then it follows that we are breeding a type of tuberculosis so virulent that it is rapidly overcoming this lack of susceptibility of the genus bos.

Tuberkulose unter halbwildem Vieh in Kalifornien.—(Baker.)

Die Meinung ist sehr weit verbreitet, dass das Leben im Freien nicht nur Tuberkulose verhindern, sondern auch heilen wird, sowohl in Menschen als auch im Rinde. Dies ist nur insofern wahr als ein Freisein von einer Infektion vorhanden ist.

Die Menge von Tuberkulose unter halbwildem Vieh, welche die Schlachthäuser bis zu diesem Punkte herausgefunden haben, beweist schliesslich dass das Leben im Freien allein nicht genügend ist, entweder um zu verhindern, oder eine Heilung zu erzielen.

Während die Verletzungen, die man bei halbwilden Stieren findet, häufig leicht, verkalkt und grösstenteils auf die Halsgegend beschränkt sind, ist es durchaus nicht ungewöhnlich, zwei bis vier Jahre alte Stiere

mit sehr bestimmten progressiven Erscheinungen zu finden, die virulente Typen von Tuberkulose zeigen, die auf frische Infektion hinweisen.

In vielen Fällen ist es unmöglich, den primären Herd zu lokalisieren, da die Verletzungen alle anscheinend desselben Alters sind; dennoch ist eine weitere Verbreitung und ein aktiveres Stadium von Jahr zu Jahr bemerkbar, während das Verhältnis allgemeiner Fälle zu der affizierten Gesammtzahl die ganze Zeit hindurch zunimmt.

Wo bekommen nun diese lebhaften, kräftigen Stiere ihre Ansteckung her? Gewiss nicht von den gerade aus den Ställen gekommenen Kälbern, da diese abgeschlossen gehalten werden; tatsächlich waren viele dieser Stiere zweifellos ursprünglich Milchkälber, und brachten die Infektion mit sich zur Herde, aber in diesen Fällen würde der primäre Herd verkalken und sich einkapseln, oder es würde Kachexie vorhanden sein, welche auf einen lang fortgesetzten Kampf gegen die Krankheit hinweisen würde, während das, was wir heute finden, notwendigerweise nicht als eine Verallgemeinerung betrachtet werden kann, und eine akute progressive Tuberkulose ist, welche deutlich auf eine frische Infektion hinweist.

Wenn es wahr ist, dass die Rinder nicht für Tuberkulose empfänglich sind, dass nur der stärkste, virulenteste Typus des Organismus die Krankheit hervorrufen kann, dann folgt, dass wir einen Typus von Tuberkulose züchten, der so virulent ist, dass sie sehr schnell diesen Mangel an Empfänglichkeit von Seiten des Rindergeschlechtes überkommen wird.

THE PREVALENCE OF TUBERCULOSIS AMONG DAIRY CATTLE IN THE VICINITY OF SAN FRANCISCO, CALIFORNIA.

By Archibald R. Ward, B.S.A., D.V.M.,
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and Clarence M. Haring, D.V.M.,
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The idea that the close housing of cattle during the winter in ill-ventilated stables, with restricted hours of exercise, constitutes an important factor in the spread of tuberculosis is quite prevalent in the northern and eastern sections of the United States. It is quite generally believed in the east that the climatic conditions prevailing in California discourage the spread of tuberculosis. This is based upon the assumption that the mild climate, permitting greater freedom for the cattle, constitutes a powerful factor in the repression of the disease. The belief is undoubtedly fostered by the popular esteem in which California climate is held as a resort for human tubercular patients.

During the past four years we have applied the tuberculin test to enough cows in central California to make the results of some interest as indicating the prevalence of tuberculosis among dairy cattle there. Our work has been confined almost exclusively to herds supplying market milk for distribution in cities. Herds for this purpose are built up and maintained by the purchase of cows rather than of raising heifers. It is the usual practice in such dairies to sell the calves to the butcher very shortly after their birth. A few herds tested by us not producing milk for city supply, and in which the calves were raised, constitute interesting exceptions to the usual conditions found. In general, then, our results are not of value in indicating the prevalence of tuberculosis in all classes of dairy cattle. We have done a very limited amount of work among that class of dairy herds supplying milk for butter- and cheese-making.

We do believe that our results form a fair basis for estimating the prevalence of tuberculosis among dairies supplying market milk. The herds tested do not represent herds that were tested especially on account of a suspicion of the existence of tuberculosis. This is frequently the case with

conclusions drawn from results of applying the test under supervision of the State, under the system of providing compensation for condemned animals. Much of our work has been done in connection with inspection of dairy herds under municipal authority, for the purpose of merely excluding the milk of tubercular cows from sale. So far as possible every herd was tested, irrespective of suspicion concerning the existence of tuberculosis. On the other hand, we have been refused permission to test certain large herds, and have good reason to believe that the refusal was based upon the fact that the owner knew the disease to be prevalent in the herd.

In the table following we have summarized certain tests, including only figures for whole herds of five cows or over, which, to the best of our knowledge had never been tested before. Results of tests of bulls are included, but no calves.

TABLE I.

Herd Number.	Location.	Number Tested.	Number Condemned.	Per Cent. Condemned.
1.....	Palo Alto	148	59	39.0
2.....	" "	45	16	35.6
3.....	" "	44	11	25.0
4.....	" "	31	1	0.3
5.....	" "	17	1	0.5
6.....	" "	14	1	0.7
7.....	" "	8	4	50.0
8.....	Berkeley	150	51	33.3
9.....	"	73	9	12.3
10.....	"	58	8	13.8
11.....	"	17	9	58.8
12.....	"	17	1	0.5
13.....	"	17	3	17.6
14.....	"	16	12	75.0
15.....	"	5	0	0.0
16	Petaluma	39	0	0.0
17.....	Withheld	196	110	56.1
18.....	Lakeville	10	0	0.0
19.....	Walnut Creek	38	10	26.3
20.....	Knight's Landing	61	15	24.5
21.....	San Matio	10	5	50.0
22.....	San Luis Obispo	8	0	0.0
Total....		1022	326	31.9

Percentage of herds found infected, 82.

This amount of tuberculosis is quite similar to, if not worse than, conditions in New York State. Moore* has combined figures obtained from work

* Moore: "Bovine Tuberculosis in New York State." A report prepared for the Joint Committee of the Committee on the Prevention of Tuberculosis of the New York Charity Organization Society and the Milk Committee of the New York Association for Improving the Condition of the Poor, page 11.

done under the direction of the Commissioner of Agriculture of New York State, and from private practitioners, and finds 32.26 per cent. reacting.

Herds 12, 13, 15, and 18 were isolated country herds, not producing market milk, and had been built up by the normal practice of raising calves. Herd 22, belonging to a State institution, was conducted in much the same way, although the foundation stock had been purchased from several sources. The larger dairies—invariably badly infected—had been built up by indiscriminate purchases of fresh cows.

One test made of part of a large dairy herd is not included in the above figures, but deserves mention. From a herd of 450 cows the foreman selected 50 fresh cows with reference to fine condition and probability of passing the tuberculin test. Those selected represented the choicest animals in the herd. The tuberculin test showed that 41 of them (83 per cent.) were tubercular.

When we come to a consideration of the results of tests of groups of five cows or less, the results are more satisfactory. Of 71 animals, only 6 (8 per cent.) reacted. The most of these cows were kept in Berkeley and pastured in vacant lots, restrained by a rope and stake. We believe that most of them had been raised under these conditions or in small isolated country herds. This practice of keeping cows represents the extreme to which animals may be isolated, and likewise presents the minimum of tubercular infection. The extent to which animals are associated with others seems to be the determining factor. Cows isolated show a low percentage of tuberculosis, while those crowded together in large herds show a high percentage.

We have made more tuberculin tests than those enumerated, but the additional ones represent examinations of selected groups of cows, or retests of herds in which similar work had been done before, resulting in the disposal of tubercular cows. In all, then, 1976 tests have been made, of which 453 (22.9 per cent.) showed reactions.

These figures of ours, it is true, do not cover a considerable portion of the State, but it is an undisputed fact that similar conditions exist in other sections of California. The information obtained by the veterinary inspectors of the United States Bureau of Animal Industry at abattoirs in California goes to prove that tuberculosis is widely distributed among dairy stock and among beef-producing animals raised on the ranges.

If it be conceded, then, that tuberculosis is prevalent in California, it may be of interest to compare the conditions under which cattle are kept in the east and in California, with reference to points of similarity and of difference.

These features in the care and maintenance of cattle are common to both California and the east. Calves are allowed to suckle cows to some

extent, or raw skim milk is fed to them without precautionary measures to prevent the transmission of tuberculosis through the milk. Cows are usually milked while standing in stanchions and eat the grain feed at that time. Many herds supplying market milk are built up and maintained through the purchase of animals rather than by raising them. Cows are uniformly subjected to the drain incident to bearing a calf each year and to the drain caused by milk production.

Here the similarity stops. Eastern cattle spend a large portion of the day in the winter in stanchions in the stable. This raises problems of ventilation, to secure for the cattle fresh air without the discomfort of drafts of air and cold. California cattle are stabled only during the time of milking,—say four hours a day,—and then in structures built so cheaply that the problems of ventilation do not need consideration. Except during milking-time, dairy cattle live a free life in the open air. During several months, when dry, the cows live out-of-doors continuously, feeding on broad ranges of pasture land.

The essential fact is, then, that dairy cattle in the east and in California have the same opportunities for infection through milk or by association together in the same stable during feeding. The amount of tuberculosis found by us in California is practically the same as found in New York—a typical eastern State in climate. The hours of confinement in the stable and climatic conditions—the two great points of difference—exert no influence on the prevalence of tuberculosis.

In connection with the control of tuberculosis in cattle we must not rely upon regular exercise, fresh air, and stable ventilation as factors in the repression of the disease. It should be recognized that with these sanitary measures tuberculosis will flourish if we neglect to take into account the tubercular cow and her milk.

La prevalencia de la Tuberculosis entre el Ganado de Leche en California.—(Ward y Haring.)

Prevalece en la porción más fría de los Estados Unidos la idea de que el mantener el ganado de leche encerrado en establos mal ventilados con horas restringidas para ejercicio, constituye un importante factor en la propagación de la tuberculosis. Se cree generalmente allá que las condiciones de clima que prevalecen en California debilitan la propagación de la tuberculosis. Esto se basa en la suposición de que un clima suave que permite mayor libertad al ganado constituye un poderoso factor en la represión de la enfermedad.

Durante los últimos cuatro años hemos aplicado la prueba de la tuberculina á suficiente numero de vacas en la California central como para hacer

de algun interes el resultado que indica la prevalencia de la tuberculosis entre el ganado de leche en aquella region.

Nuestra trabajo se ha circunscrito en gran parte á los rebaños que suplen el mer cado de leche para distribución en las ciudades. Los rebaños para este propósito son criados y mantenidos con la compra de vacas màs bien que por la cría en rebaños.

Los rebaños probados no representan aquellos que se probaron como resultado de sospecha en cada caso particular. Mucha parte de nuestro trabajo ha sido hecho en unión con la inspección de los rebaños de leche bajo la autoridad municipal, con el propósito de excluir la leche de las vacas tuberculosas que intenta venderse. Tanto como fué posible, cada rebaño fué probado independientemente de sospecha alguna respecto á la existencia de tuberculosis. Se nos ha sido rehusado permiso para probar grandes rebaños, y tenemos buenas razones para creer que ello se basa en el hecho de que el propietario sabía que la enfermedad prevalecía en el rebaño...

Hemos probado 22 rebaños, que contenían 1022 vacas por todo, de las cuales 326, ó sea 31.9%, dieron reacción. 82% de los rebaños estaban infectados. Estos numeros solo incluyen rebaños enteros de cinco vacas ó más, que nunca habían sido sometidas á prueba antes.

Este percentage corresponde muy aproximadamente con los resultados obtenidos en el Estado de Nueva York.

Cuando consideramos los resultados de pruebas de grupos de cinco vacas, ó menos, las conclusiones son más satisfactorias. De 71 animales, solo 6 (8%) dieron reacción. Las más de estas vacas eran tenidas en Berkeley, California, y eran pasteadas en lotes vacantes y amarradas por una cuerda á una estaca. Este modo de tener vacas representa el extremo á que pueden aislarse los animales, y por tanto indica el minimum de infección tuberculosa.

Estos hechos en el cuidado y mantenimiento del ganado son comunes tanto á California como al Este. Se permité á los becerros mamar las vacas hasta cierto punto ó se los alimenta con nata de leche cruda sin medidas precautelativas para prevenir la trasmisión de la tuberculosis por medio de la leche. Las vacas son comunmente ordeñadas de pió sobre puntales y en ese momento comen el alimento de granos que les dan. Muchos rebaños que suplen el mercado de leche son hechos y mantenidos con la compra de animales más bien que por la crianza. Se somete á las vacas á la contribución uniforme de tener un becerro cada año y á la causada por la producción de la leche.

Hasta aquí la semejanza. El ganado en el Este pasa gran porción del día en invierno en puntales en el establo. Esto trae problemas de ventilación para asegurarle al ganado aire fresco sin disturbios por corrientes de aire y por el frío. El ganado de California es mantenido en el establo solo

durante el ordeño, ó sea cuatro horas al día, y en tan baratas estructuras que el problema de la ventilación no necesita considerarse. Excepto en el ordeño, la vaca de leche vive vida libre en campo abierto. Durante varios meses, durante la sequía, las vacas viven afuera continuamente, alimentándose en anchos campos de pasto. El hecho esencial es, pues, que el ganado de leche en el Este y en California, tiene las mismas oportunidades para la infección por la lehce, ó por la asociación en el mismo establo durante la alimentación. El pobre percentage de tuberculosis en las vacas de la ciudad puede explicarse por el aislamiento individual que evita el estrecho contacto con otros. Las horas de confinamiento en el establo y las condiciones de clima, los dos grandes puntos de diferencia, no tienen influencia en la prevalencia de la enfermedad.

Das Vorherrschen von Tuberkulose unter den Milchkühen in der Umgegend von San Francisco, California.—(Ward und Haring.)

Die Idee, dass enges Beisammensein von Rindern während des Winters in schlecht ventilierten Ställen mit beschränkten Stunden von Umhergehen einen bedeutenden Faktor in der Ausbreitung der Tuberkulose darstellt, ist in den kälteren Gegenden der Vereinigten Staaten ganz weit verbreitet. Dort glaubt man allgemein, dass die in California herrschenden klimatischen Verhältnisse der Ausbreitung der Tuberkulose hinderlich sind. Diese gründet sich auf die Annahme, dass das grössere freiheitlassende milde Klima einen mächtigen Faktor in der Unterdrückung der Krankheit bildet.

Während der letzten vier Jahre haben wir die Tuberculinprobe bei genug Kühen in Mittel-California angewendet, um die Resultate interessant genug zu machen um anzuzeigen, dass die Tuberkulose unter den Milchkühen jener Gegend vorherrscht.

Unsere Arbeit beschränkte sich hauptsächlich auf Herden, welche die Milch für den Verkauf in den Städten liefern. Herden für diesen Zweck werden aufgebaut und unterhalten mehr durch den Kauf von Kühen als durch Aufziehung von Kälbern.

Die geprüften Herden stellen nicht diejenigen dar, die als ein Ergebniss von Verdacht in einem besonderen Falle geprüft worden waren. Ein grosser Teil unserer Arbeit wurde in Verbindung mit der Prüfung von Milchkühen unter Gemeinde-Aufsicht ausgeführt, um die Milch von tuberkulösen Kühen vom Verkaufe auszuschliessen. So weit als möglich wurde jede Herde, ganz abgesehen von dem Verdacht des Vorhandenseins, geprüft. Die Prüfung gewisser grosser Herde wurde uns verweigert, und wir haben guten Grund zu denken, dass die Verweigerung auf der Tatsache beruhte, dass der Eigentümer von dem Vorhandensein der Krankheit in seiner Herde wusste.

Wir prüften 22 Herden, zusammen 1022 Kühe, von denen 326, oder 31.9% reagierten. 82% der Herden waren infiziert. Diese Zahlen schliessen nur ganze Herden von fünf oder mehr Kühen ein, die vorher noch nie geprüft worden waren.

Dieser Prozentsatz stimmt sehr genau mit dem in New York erhaltenen ein.

Wenn wir die Resultate von Proben von Gruppen von fünf oder weniger Kühen betrachten, sind dieselben mehr zufriedenstellend. Von 71 Tieren reagierten nur 6 (8%). Die meisten dieser Kühe waren in Berkeley, California, und waren auf der Weide in unbebauten Plätzen und mit langen Seilen angebunden. Diese Weise der Haltung von Kühen stellt das Extrem dar, wie die Tiere isoliert werden können, und bietet auch das Minimum der Tuberkelansteckung.

Diese Züge in der Pflege und der Haltung von Rindern sind dieselben in California und dem Osten. Kälber dürfen zu einem gewissen Grade an den Kühen saufen, oder rohe abgerahmte Milch wird ihnen ohne besondere Massregeln zur Verhütung der Üebertragung von Tuberkulose durch die Milch gefüttert. Die Kühe werden gewöhnlich gemolken während sie in einem Stalle stehen und zur selben Zeit Kornfutter fressen. Viele Herden, die Milch für den allgemeinen Markt liefern, werden mehr durch den Ankauf von Kühen als durch die Aufzucht aufgebaut und erhalten. Die Kühe werden gleichmässig der Aussetzung des jährlichen Kalbens, also auch der der Milchproduktion unterworfen.

Hier hört die Ähnlichkeit auf. Rinder im Osten bringen während des Winters einen grossen Teil des Tages in Ställen zu. Dieses stört das Problem der Ventilierung auf, um den Rindern frische Luft ohne die Unbequemlichkeit kalter Luft zu liefern. Californische Kühe werden nur während des Melkens in die Ställe gebracht—sagen wir vier Stunden im Tage—und dann in Gebäuden so billig hergestellt, dass die Ventilierung nicht in Betracht kommt. Ausser während des Melkens leben die Milchkühe ein freies Leben im Freien. Während einiger trockener Monate sind die Kühe ständig im Freien und fressen auf grossen Weiden.

Die wesentliche Tatsache ist daher, dass die Milchkühe im Osten sowohl als auch in California die gleichen Gelegenheiten für Ansteckung durch Milch oder durch das Zusammensein in demselben Stalle während der Fütterung haben. Der niedere Prozentsatz von Tuberkulose in Stadtkühen kann wohl der Isolierung von anderen Tieren zugeschrieben werden. Die Stunden der Einsperrung und die klimatischen Verhältnisse—die zwei grossen Unterscheidungspunkte—üben keinen Einfluss auf das Vorhandensein der Tuberkulose aus.

TUBERCULOSIS OF CATTLE FROM THE POINT OF VIEW OF THE FARMER.

By Professor Jesse E. Pope,
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The sections of this Congress concerned with the suppression of tuberculosis among human beings can make the inspiring announcement that practically everywhere the disease is on the decline; while the sections occupied with the problem of tuberculosis among domestic animals must announce that thus far all efforts even to check its advance have, with few exceptions, failed; for in nearly all lands bovine tuberculosis, and hence tuberculosis of other animals, is on the increase.*

It is true that animal tuberculosis presents peculiar difficulties; but in view of the facts that since 1892 we have had a delicate and certain test for aiding early diagnosis, and that it is within the realm of possibility to destroy all diseased animals at once, the situation is humiliating.

The cause of this failure to make progress against animal tuberculosis is not far to seek; measures for combating the disease have been ill considered or inadequate, or have proved abortive from failure to win the farmer's co-

* The following table, compiled from the reports of the Bureau of Animal Industry, shows trend of disease among animals slaughtered subject to Federal inspection:

Year.	Cattle.		Hogs.	
	Number Condemned.	Per Cent. Condemned.	Number Condemned.	Per Cent. Condemned.
1901	6434	10	8650	0.035
1902	7944	14	14927	0.059
1903	8598	14	20299	0.092
1904	10173	16	34656	0.143
1905	10956	18	64919	0.256
1906	13548	19	95896	0.321
1907	19305	25	65618[a]	0.25

[a] In 1907, 364,559 parts were condemned, as over against 113,491 in 1906.

The slaughter records of Europe show the same trend. (See United States Department of Agriculture Bulletin No. 38.) Even in Denmark the 1907 report of the coöperative slaughteries shows slight increase of disease among hogs. (Andelsbladet, April 3, 1908.)

operation and support, upon which must ultimately depend the success of our crusade. The farmer's opposition is due to his failure to appreciate the seriousness of the situation, to his distrust of the remedies proposed, and, above all, to the fact that the financial burden imposed on him seems out of all proportion to the benefits he is to receive. He is told that certain animals in his herd are afflicted with a highly infectious disease, and that his family and, if he is a dairyman, his customers are in grave danger of catching consumption. To the charge that his herd is diseased he points out that his animals are sleek and glossy and, to all appearances, in prime condition. It is true that from time to time a cow "goes bad" and must be disposed of, and sometimes animals go into a decline and die; but the farmer is accustomed to losing stock now and then; and by the American farmer in particular such losses are accepted as a matter of course. To the warning against consumption he points to his rosy-cheeked children, and declares that for generations there has been no consumption in his family, though they have always drunk raw milk.*

If he is engaged in general farming and sells stock on the market, he usually sees no connection between the price paid for his animals and the presence or absence of the disease. If he is a breeder of registered cattle, his customers do not demand a certificate of health, or if they do demand it, are unwilling to pay for the trouble and risk. He has seen animals pronounced diseased by the tuberculin test and slaughtered which, on post-mortem, have been declared sound; and, on the other hand, he has seen animals pronounced sound which, in a short time, died of general tuberculosis. He is told to ventilate his stables and to disinfect them; but he observes that animals are tuberculous which are never put in barns; and after complying with the regulations, he discovers that in a comparatively short time conditions are as bad as before.†

In America he has seen the law applied ruthlessly in one case and not at all in another; his own herd has been singled out for condemnation, and his neighbor's, which he believes to have been as bad as his, has remained unmolested.‡ By hysterical notoriety his business has been injured to an extent which cannot easily be estimated. In many cases the requirements of the law have increased the fixed charges of carrying on his business, and, being unable to shift the expense to the consumer, he naturally feels resentment. His compensation for condemned animals has been inadequate or

* The apparent immunity of country children from bovine infection may be partially due to the fact that country mothers usually nurse their children, and to the further fact that country people as a class are not large consumers of raw milk.

† "Some of the worst outbreaks we have investigated were confined to animals that never had been kept in barns." (Bull. No. 29, Iowa Experimental Station, p. 254.)

‡ A farmer of unusual insight, formerly a breeder of registered stock, writes me: "They [the farmers] see only its [the tuberculin tests] application in isolated cases, and so can see no broad beneficial results. They are right."

uncertain, or the delay and trouble in collecting it out of all proportion to the amount.*

If he sells his cattle on the market, he must meet the demands of Federal inspection; if he buys from or ships to another State, he must meet the interstate regulations; and if he sells milk, he must comply with those of the municipalities wherein are his customers. All along the line there are confusion, uncertainty, trouble, and expense; and he is not convinced that any one is benefited or that the disease is being stamped out; but he is sure that he is willing to bear the loss from the disease if only he can be let alone.

Doubtless much of the farmer's resentment grew out of the hasty, harsh, and crude regulations of the nineties,† when bovine tuberculosis and the tuberculin method of diagnosis were imperfectly understood and the enforcement of the law was left to ignorant and unskilful officials; but despite the great advance made since then, the farmer feels that he still has just grounds for complaint.

The early policy of ruthlessly slaughtering all infected animals without compensation has been largely abandoned. To-day, before a herd is subjected to the tuberculin test, each animal is appraised at its market value. Those showing physical signs of the disease are slaughtered without compensation or with nominal compensation. Reacting animals which on postmortem examination show general tuberculosis are usually paid for at a lower rate than those in which the disease is localized. The usual custom is to fix a maximum flat rate of payment, which is higher for registered than for common stock. In Pennsylvania, for example, the maximum compensation for an animal of common breed is $25, and for a registered animal $50; in Wisconsin the maximum appraisal is $50; in Massachusetts it is $40, of which 40 per cent. is paid in case the animal is found to have general tuberculosis and 60 per cent. if the disease is localized; in New York these figures are 50 per cent. and 80 per cent. respectively; in Minnesota the maximum is fixed at $35 for common stock and $75 for registered. In some States, Illinois, for example, no provision is made for compensation.

A farmer who does not wish to accept these terms may dispose of his cattle for beef, but waives his right to compensation. Before receiving payment for condemned cattle the farmer must thoroughly disinfect his premises and put them in sanitary condition, and must agree to submit his herd to future tests and not to introduce untested animals into it. In order to have his herd tested free, he must, as a rule, make application, giving his reasons for believing his herd diseased; and in case he cannot do this, he must himself bear the expense of testing. To obtain compensation for his cattle he

* See New York Animal Sanitation Committee, p. 7, 1901.

† "The kill-all-without-compensation method early advocated by some extreme scientists and veterinarians is largely responsible for the farmers' antipathy to the tuberculin test." (Personal letter from editor of "Breeder's Gazette.")

must show that they have been in the State a minimum length of time, which varies for different States: in New York it is six months, in Wisconsin four months, and in Massachusetts it is one year.

This system of compensation the farmer considers inadequate and unfair. Since, under the most favorable regulations, the maximum payments cover only a bagatelle of the direct financial loss, and since to this loss must be added the expense of meeting the other requirements of the law, even moderate infection of a herd must often result in the owner's ruin. The farmer does not expect large compensation for animals showing physical signs of the disease; they are not many, and his sense of fairness is met. But he feels that $25 for a dairy cow in full milk or about to drop her calf is not enough; for he cannot replace her for less than two or three times this amount. To ask a breeder of registered animals to accept $50 or even $75 for each of his reacting animals is to ask him to erect his own financial scaffold. The alternative of selling cattle for beef helps matters but little; for dairy cows are seldom fit for beef, and in case of registered stock the objection is obvious. The farmer cannot understand why compensation should be refused for cattle imported from another State; as a dairyman must often replenish his herd with cattle from a distance, it frequently happens that he has many cattle for which he must run the risk of standing the entire loss, unless he waits some months before cleaning up his herd. Nor can the farmer understand why he must bear the expense of testing simply because he is not sure that his herd contains tuberculous animals.* He is asked to bear the expense of the test unless he is sure that his herd is diseased, supposedly on the ground that advertisement of the fact that his herd is free from tuberculosis will redound to his benefit, and that therefore he ought to pay the cost of testing. Perhaps he ought, as a matter of justice, but this seemingly hostile attitude of the authorities or lack of interest repels him; he does not take the step, and his good example is lost.

Within the State the test is not compulsory; and since the seller of cattle is not compelled to use it, the farmer who has cleaned up his herd and is obliged to replenish it with tested cattle must bear the risk of the test by paying a higher price. The farmer who voluntarily cleans up his herd and sends his reacting cattle to market is not only heavily mulcted for the diseased parts, but must also suffer the usual discount on the price of cattle from an infected region, despite the fact that since he sells his cattle subject to test the packer runs no risk.†

When an animal, often of great value, is found on post-mortem to be only

* Russell found that in Wisconsin 20 out of 42 unsuspected herds contained tuberculous members. (Wisconsin Agricultural Experimental Station Bulletin 84, March, 1901, p. 4.)

† The condition of affairs as it exists in Iowa is excellently set forth in Wallace's "Farmer" for July 13, 1908.

slightly infected, or is even pronounced sound, the owner feels the loss keenly and regards the appraisal value as wholly inadequate. But even if adequate compensation were to be made for the direct financial loss, there would still remain certain losses, not easily measured, it is true, but to the farmer none the less real, for which compensation cannot easily be rendered.

The opposition of the farmer, together with the failure of the State to provide adequate funds,* has led to the application of the Bang system, under which the farmer may, if he so chooses, retain reacting animals on his farm, provided they are kept isolated. This means separate pastures, separate barns, and, when possible, different sets of helpers. All milk from diseased cattle must be pasteurized; their calves as soon as dropped must be removed; and the well herd must be submitted to frequent tuberculin tests.

When first introduced, the Bang method seems to satisfy the farmer; but it soon loses favor with him. It involves much trouble and expense and the farmer receives no financial aid from the State. The necessity of pasteurizing the milk from reacting cows may mean heavy loss to the dairy farmer, because under present conditions pasteurized milk cannot be sold at all or must be disposed of at a lower price than that of raw milk, although its cost of production is greater; indeed, it is exceedingly doubtful that pasteurized milk from cows known to be tubercular can ever find a market. Few dairy farmers are in the position to maintain a double equipment;† the persistent carrying out of the regulations necessary to prevent infection of the well part of the herd, and, in general, the building up of a sound herd by this method, involve trouble and expense which will not pay except in the case of fine milking strains. What has been said of the dairy farmer applies with even greater force to the general farmer, whose system of farm management makes the application of this method impracticable.‡

In the districts where milk is sent to a central creamery, the skimmed milk returned is a fruitful source of infection. Laws have been passed providing that it be pasteurized, but in most cases creameries do not obey them, and even if they did, the custom of not running creameries on Sunday would partially nullify the law because of the impracticability of pasteurizing the milk

* In some States no compensation is allowed; in other States the laws granting compensation have been nullified by failure to make appropriations; while in others the amount allowed has been inadequate and the appropriation has become exhausted; in no single State has the appropriation been adequate to wage an effective campaign against the disease.

† However good sanitation, there will be infection if well and diseased animals are kept in same stable. (Dr. Leonard Pearson, Pennsylvania Bulletin, Department of Agriculture No. 74, 1901, p. 8.) Bang states that a connecting door is dangerous, and that whenever it is possible there should be separate farms. (Ibid., Bull. 75, p. 258.)

‡ Mr. Henry Wallace, who is intimately acquainted with American farm conditions, writes me: "I do not think that the Bang method of treatment will be practicable on the average farm, not so much because of the extra labor and expense, but because the farmer ordinarily would rather stand the loss than to go to so much trouble."

of Sunday and of Monday morning. When the farmer owns his own separator and has infected cows, pasteurization becomes necessary, but he is seldom in the position to afford the labor and trouble involved. In Denmark, it is true, where the home separator is not common, the central coöperative creameries do faithfully pasteurize the skimmed milk; but the Danish farmers are used to taking infinite pains, and have learned to follow the advice of science, and, moreover, the economic pressure due to the very great importance of dairying in Denmark must be taken into account. In beef-producing regions, where calves run with their dams, the method can, of course, not be applied.

In the case of the breeder of registered stock the conditions are not the same. He usually employs a better class of labor, and his more elaborate and expensive farm improvements enable him better to carry out segregation; but breeders who accepted the Bang method with enthusiasm have, after trying it, become doubtful of its practicability, owing to the trouble and large expense of maintaining isolated herds and the costly mistakes entailed by frequent testing of animals; well animals are often slaughtered and, more serious still, sick ones are often retained in the herd; for the breeder's experience seems to be that in certain stages the disease can be detected neither by physical examination nor by the test.* The difficulty of avoiding mistakes is strikingly shown by the fact that at the recent international fat stock show the steer which had been fed by one of our leading agricultural colleges and which surpassed all former records and brought the highest price after passing all the experts was, on post-mortem, found to be so badly infected with tuberculosis that the carcass was unfit for food.

* Hon. W. C. Edwards, of Rockland, Ontario, owing to his public spirit in dealing with tuberculosis in his own herd, has been widely quoted as to the efficiency of the Bang method. The following extracts from a personal letter, written in September, 1908, ought to be of interest: "I most certainly think that the Bang system is a most excellent one for any one to practise. I may say, however, that I do not think that many farmers, or even breeders, will go to the expense and trouble involved in the practice. Personally, I may say that the riddance of tuberculosis through the Bang system is very effective; but it is very expensive to practise as we practise it here. If I had to do it over again, my plan woud be to found a distinctly new herd on a separate farm, or removed some distance from the buildings of our present farm, in an entirely new set of buildings or buildings thoroughly disinfected. There keep a certain number of thoroughly healthy nurse cows, and from each cow of our pure-bred herd that we wish to make the foundation of our new herd, take the heifer calves as immediately dropped and remove to our new premises. And through this process in a few years have an entirely new and fresh herd." Mr. Edwards insists that with the most careful testing you can never be sure that you have weeded out all affected animals, since "Some of your finest and most robust animals are those which have the disease in the most severe form, which clinic examination cannot discover. While I am a believer in the test [tuberculin], I am not a believer that it is efficacious in every instance, and herein lies the danger of it. It, however, can be made useful and is useful in many ways. But in applying it year after year, or even every six months, to ascertain the real condition of the herd, the most serious mistakes can be made and are made. This, I frankly tell you, has been our greatest difficulty, and has resulted in enormous loss to us. So much so, that I am going to practise exactly what I have stated above, viz., I am going to have an entirely new, separate, and distinct herd."

In so far as the question of compensation is concerned, neither the slaughter of infected animals nor their retention under the Bang system satisfies the farmer; under either procedure the financial burden entailed seems to outweigh the gain which comes to him; and only under pressure exerted by the consumer of his milk does he coöperate with the State in fighting the disease.*

We are led here to take up the attitude of the farmer toward the tuberculin test. I know of nothing that has so hampered the fight against bovine tuberculosis as the almost universal distrust of the tuberculin test which prevails among farmers. No doubt this is due partly to the natural conservatism of the farmer, partly to influence exerted upon him by supposed authorities, and partly to the fact that the test affords the means of attack upon his herds. But after due allowance is made for these factors, there still remain justifiable grounds for the farmer's opposition. Those who applied the test in the past have made many blunders, and to-day the mistakes are so many and so widely known that the veterinarians, or those who claim this title, have much to answer for. The custom is to apply the test and, in case of reaction, to test its correctness by careful post-mortem examination. This puts the one who applies the test on the defensive, and in case disease is not found, the farmer is filled with anger and contempt, even though he is paid full market value for the animal which he believes to have been mistakenly condemned. A mistake such as occurred recently in Minnesota, where four out of eleven animals slaughtered were pronounced perfectly healthy, will prejudice an entire community against the test. What is even more serious, animals far gone with disease are often pronounced sound and left in the herd. Veterinarians venture to assert that physical examination can discover such animals; but the farmer's experience is against this contention, for in many instances such cattle have passed the physical test and yet have died from the disease a few months later.†

To the breeder of fine stock such mistakes are grave indeed. They may result in the useless sacrifice of a healthy animal and the retention in the herd of an animal the presence of which will make such sacrifice worse than useless. My conviction is that unless such mistakes can be avoided, the oppo-

* This tuberculin [that sent out by the department] has been used almost exclusively for testing dairy cattle." (Distribution of tuberculin, etc., by the Bureau of Animal Industry, Year Book of Department of Agriculture, 1906, p. 352.)

† The farmer mentioned in a former foot-note also relates an incident which throws so much light on the psychology of the question from the farmer's view-point that it is well worth a place in this paper. When he dispersed his herd, he sold an unusually fine cow to a farmer living in another part of the State. Meeting the purchaser at the fair some time later, he was told that the cow had a fine calf and was the finest cow in the herd. "A year later I met him again and asked about the cow. He told me that he had had the herd tested, and that she had been condemned and killed and that post-mortem had revealed nothing the matter with her; that she was apparently still the finest cow he had and that the useless slaughter made him feel very sore."

sition to the extensive use of the test will be overwhelming—a condition of affairs which would be most unfortunate.

The tuberculin test has not been made compulsory. Such a step would be bitterly opposed by farmers, not so much perhaps because of lack of faith in the test's efficiency as because of inadequate compensation received. Dealers in milk have encouraged this opposition because they fear if the test were to be made compulsory the farmer would demand more for his milk, and that the price to the consumer could not be proportionally raised. This fear is well grounded. Many people who favor the test for cows supplying milk for cities do not deem it generally necessary. Breeders, conscious of the high degree of infection in their herds, have exerted their powerful influence against the test. As the result of all of this opposition, the authorities have timidly hesitated to make it compulsory, feeling that sufficient funds would not be forthcoming to make possible the carrying out of the law.

The farmer sees little logic in the requirement that cattle shipped in from another State shall pass the test when those bought within the State are not subjected to it. Why should a New York farmer, for example, be permitted to buy an untested bull from within his own State, but not from Pennsylvania? The chance of getting a diseased animal is no greater in the latter case, and what is to be gained if his own herd is not free from the disease? Though led to believe that the disease is highly contagious, he sees feeders and cattle for show purposes exempted from the test to which cattle for breeding and dairying are subjected; yet he knows that many of these feeders are worn-out dairy cows, which are shipped to the city to be sold to farmers and by them turned into beef. That such feeders are scattering the disease into non-dairying districts is a well-known fact.* The wisdom of the policy of exempting show cattle from the test is, as far as its effect upon the stamping out of tuberculosis is concerned, extremely doubtful.

While not wishing to take up the problem of control, let me indicate the lines along which it seems to me that measures must be framed in order that State and farmer may effectually coöperate in stamping out tuberculosis. The farmer feels that the direct financial loss should be met by society as a whole, which, as consumer, would be more than repaid for the expenditure, and that the indirect costs which he must bear constitute his own fair contribution. With better compensation and careful regulation, the opposition of

* The following case, furnished me by a physician of high standing, is well worth recording. In the spring of 1900 a farmer of Adair County, Iowa, shipped in a carload of young feeders from New York State. These cattle were separated from his herd by a barbed wire fence. Some months later the farmer's fourteen-year-old daughter was taken ill with miliary tuberculosis. On investigation it was discovered that she had been drinking milk from cows which were suffering from tubercular diarrhea, and some of which died later with acute tuberculosis. The farmer lost two-thirds of the cattle shipped in and his home herd was practically ruined by infection; yet he lost his suit for damages against the man who had sold him the infected cattle.

the average farmer to the compulsory test would, I believe, disappear. As soon as an animal is known to be tubercular it should become the property of the State, and if destroyed, should at once be paid for at its full market value, unless it shows physical signs of the disease. This procedure would do away with the fruitful source of disputes over paying for animals after post-mortem and recouping for sound animals slaughtered. No longer would time and money be spent in painfully and minutely going over a carcass to find lesions often too slight to convince the farmer that he has not been defrauded. The uncertainty as to the amount of his compensation and the time when he is to receive it ought to be removed.

Until the disease is stamped out, cattle sold on the general market should be marked in such a way that those which, on slaughter, prove to be tuberculous can be traced back to the farmer, who should, however, receive for them the full market value, on condition that he shall immediately proceed to clean up his herd. The local butcher and packer ought not to stand the loss from buying tuberculous cattle, for they at once protect themselves by throwing the cost back on the farmer, who becomes irritated.

In the warfare against tuberculosis the coöperation of the stock-breeder should most earnestly be sought; for it is he that has most at stake, and it is his stock that we can least afford to destroy; yet he has scattered the disease from Sweden to Argentina, and is still doing it.*

The farmer is urged to improve his stock, but what is to be said when by so doing he runs nine chances in ten of introducing tuberculosis among his animals? Despite this startling condition, breeders as a class have refused to make use of the tuberculin test. At a sale of high-bred Holstein stock at Syracuse, New York, June 5, 1908, no purchaser demanded that the cattle should pass the tuberculin test. In dairy districts some breeders have advertised that their cattle are sold subject to test; but they are exceptions;† and in view of the tremendous financial loss involved under the present system of compensation, nothing better could be expected. No one thing could more aid in the suppression of tuberculosis than giving to the breeder financial support sufficient to encourage him to take steps toward furnishing farmers with breeding stock above suspicion. Some scheme must be devised whereby the State can coöperate with the breeder in building up sound herds by the Bang method or a modification of it.

We have said that the average farmer finds the Bang method impracticable; but the immediate slaughter of all infected animals would be, at

*Russell mentions a case where one breeding herd scattered infection to sixteen farmers' herds. (Wisconsin Agr. Exp. Sta., Bull. 114, p. 8, June, 1904.)

†The English breeders of short horns refused to have their animals subjected to the tuberculin test. (Select Committee on Tuberculosis, p. 10.) It is, however, reported that many breeders in the middle west are about to adopt the practice of selling all cattle subject to test.

best, wasteful and expensive, and in dairying regions it is out of the question. Where the degree of infection is relatively low, it would be possible for the State to remove all infected animals to special quarantine farms, where they could be handled in the wisest and most economical way. This work could well be placed under the control of our State colleges of agriculture, to which the problem would present little difficulty. In the dairying districts the higher degree of infection and the importance of keeping the reacting animals for breeding purposes make the problem more difficult; for the more intimate working together of the State and the individual farmer is imperative. But all that is required is that the State shall take charge of reacting cattle in close enough proximity to the owner's farm to afford him easy access to them. It would, of course, be impracticable for all infected cattle to be taken in charge at once; a given region would have to be districted and careful provision be made so that districts cleaned of the disease would not become reinfected.

The questions of sanitation and disinfection have occasioned much irritation; unless a great deal of common sense is used by the authorities, the changes required in buildings and premises are so expensive that farmers revolt or go out of business. What State and farmer need fully to grasp is that the presence of infected cattle is frightfully and persistently expensive, and that the necessary precautions are so costly and troublesome as to be hardly possible, while even when they are consistently taken, the results obtained are often most discouraging. Disinfection is a science, and the average farmer is quite incapable of carrying it out himself; time, skill, and proper appliances are lacking; and therefore disinfection by the farmer is usually a mere farce. It is unnecessary to add that unless this work is thoroughly done it is quite useless to clean up the herd.

In thus presenting what appears to me to be the attitude of the average farmer toward bovine tuberculosis, I do not wish to give the impression that I think his position always reasonable or even just, or that I feel that he has always assumed his fair share of responsibility. But a man acts in exactly the same way from imaginary grievances which he believes to be real as from real grievances. Since this is the case, and since, under the most liberal treatment, the burden of stamping out tuberculosis must rest upon the farmer, it will be wise to satisfy his sense of justice and overcome his opposition by affording him liberal aid until the disease is well in hand; but as soon as this has been accomplished it should clearly be set forth that the individual must be strictly responsible for keeping his herd free from the disease, and must himself bear the expense. When this time shall have arrived, it is the business and the duty of the veterinarian to determine. If experience teaches us anything, it teaches us that sporadic, vacillating, penny-wise

combating of the disease exasperates the farmer, wastes the money expended, and makes the ultimate stamping out of bovine tuberculosis increasingly difficult.

DISCUSSION.

Dr. Reynolds (Minnesota): I am glad to hear the farmer's view expressed on this subject. This paper should serve to awaken us, and I am glad to attend an association where there is a farmer who can present the farmer's side of the question. We have made very slow progress, as there has been no coöperation with them—we worked as separate individuals. The great body of city dairymen are very progressive men, and there are a number of propositions involved in this tuberculosis problem. These men consider the seriousness of tuberculosis, but nevertheless they are restless and ready to fight hard any movement which will injure their business. We can therefore understand their antagonism. One important problem which we should solve is a better utilization of the tuberculous cow. This is one of the most important questions confronting us. Cannot the tuberculous cow be better used for some other purpose than to destroy her? I think we should buy the tuberculous cows at their average carcass value, and use them in some way by which we can get some products; then label these products honestly and place them on the market. Can these propositions be carried out? If not, there is no other better proposition than to kill the cow and get what price you can. There are two reasons why owners of tuberculous cattle should receive some reimbursement, and it is equally fair that they should bear some of the loss. A pure-bred cow may be capable of raising a calf which may be worth $200 or $300 at birth. Whether such an animal should be kept isolated or killed should be determined purely from an economical standpoint. This should be considered, in view of the fact that we pay $35 or $40 for a healthy ordinary cow. Now, there are a number of points which interest me very much. With reference to the tuberculin test, I would like to cite some cases in Minnesota where the tuberculin test gave a reaction in animals which on post-mortem examination failed to show the presence of tubercular lesions. In Minnesota we have proposed a rule which specifies what should constitute a tuberculin test which we will receive as satisfactory and upon which we will reimburse owners. One essential is that the test should be made by a reliable veterinarian, as the failure of reacting animals to show lesions may be often attributed to a neglectful application of the test. The farmer should be impressed with the seriousness of the tuberculosis problem, and the veterinary profession should impress upon him the grave nature of that plague.

Dr. Turner: I think the farmer fails to appreciate his position as a pro-

ducer of healthy food, owing to the fact that he does not read current literature on the subject and therefore is not posted. I am unaware as to how tuberculosis of hogs can be properly handled unless the farmer is better educated along the lines of tuberculosis in his cows. Too many farmers go along in the same old rut year after year. Their complaints are frequently unjust, as they fail to follow the modern progress and are neglectful in undertaking any steps toward eradicating the disease from their herds. Such an earnest attempt would not only eradicate the disease from their herds, but it would also prevent the hogs from an infection which is always closely allied with tuberculosis of cattle on the same premises. Compulsory dairy inspection, where it is practised, certainly seems to diminish the number of tubercular animals in herds.

Prof. Bang: I cannot understand why my method is impracticable in this country. The isolation should not work any hardship on the farmer, but the destruction of the affected animals, which sometimes number as high as 80 per cent., might cause the ruin of the farmer. On the other hand, by isolation he may continue to use the animals for breeding and thereby build up a clean herd. If the cows are not highly affected with tuberculosis and there is no tuberculosis of the udder, the milk is free from tubercle bacilli, and there is no reason why that milk should not be used. The public prejudice against such milk which seems to prevail in this country is not justified. Besides, in Denmark, butter is always made from pasteurized milk, and accordingly the butter is always wholesome, and the milk of the isolated affected animals may thus be utilized in all cases.

Dr. Reynolds: If Mr. Pope will give us an outline of his plans for controlling the disease, we shall be glad to discuss them.

Mr. Pope: I am not a veterinarian, but I am very much interested in this problem of control. In the State of Iowa the bulk of the milk goes to the creameries. It is perfectly well known that tuberculosis is bad in that State, and the segregation of cattle there proved to be a difficult task for the farmer. The greatest objection to the Bang system is the difficulty in isolating the affected animals. This necessitates the farmer taking care of two distinct herds. It seems that the State colleges are better equipped for carrying out this system, but the farmer cannot do so. It seems that it would be of advantage to bring the affected cattle under State control to places such as the experiment stations, agricultural colleges, or State farming districts or centers, and under the supervision of these institutions the Bang system could probably be carried out effectively. Besides the isolation, the pasteurization of milk is almost impossible for the farmers, and with the limited help at their disposal it would be nigh impossible to carry out all the details in connection with this system. If tuberculosis is as serious a question as it would appear from these papers, far more strenuous measures will have to

be adopted; and if the farmers are opposed to these measures, you can do nothing. Farmers have been fined and imprisoned in England for not carrying out the law, and yet practically nothing has been accomplished there. The whole question of compensation is a question of getting the farmers' coöperation. If this is obtained, more than half of the battle of controlling tuberculosis is won. The indirect losses to the farmers are so heavy that even the market value of his animals would not compensate him. It is not true that the unintelligent men of this country are the ones opposed to the tuberculin test, as many of these men are doctors, lawyers, bankers, and retired business men. If you are a breeder of cattle and you think that 90 per cent. of them will react to the test, you are not going to submit to it. You would be ruined, and you know it.

SECTION VII.

Tuberculosis in Animals and Its Relations to Man.—(*Continued.*)

THIRD SESSION.

Wednesday morning, September 30, 1908.

THE PATHOLOGY AND BACTERIOLOGY OF TUBERCULOSIS IN ANIMALS.

Section VII of the International Congress on Tuberculosis was called to order, for its third session, at half-past nine o'clock, on Wednesday morning, September 30, 1908, by the President, Dr. Leonard Pearson.

TUBERCULOSIS IN WILD ANIMALS IN CAPTIVITY.

By W. Reid Blair, D.V.S.,
New York Zoölogical Park, N. Y.

My studies on tuberculosis as presented in this paper have been principally confined to the animals in the primates collection, owing to the fact that, with few exceptions, the animals in the New York Zoölogical Park, outside the monkey collection, have been remarkably free from tuberculosis.

Lesions: The general characters of the lesions produced in Simian

tuberculosis correspond, very closely to those of the human, and the bacilli found also simulate morphologically those of the human infection.

The tubercular lesions of monkeys are very extensive, practically every organ in the thorax and abdomen having been found invaded by the disease. As will be seen by the accompanying table, showing the anatomical distribution of tubercular lesions in animals examined in the New York Zoölogical Park, pulmonary tuberculosis is by far the most frequent form of the disease as found among monkeys.

Lungs: The lungs are usually affected by the miliary or nodular form of tuberculosis. The absence of pulmonary hemorrhage in monkeys in connection with pulmonary tuberculosis is a striking feature of this disease, and is accounted for largely by the fact that in the miliary form of tuberculosis, destruction of tissue and ulceration are quite limited.

The pulmonary cavitations so common in human tuberculosis are exceedingly rare in monkeys, very few cases having ever come under my observation. Chronic tubercular lesions are also much more infrequent in the monkey, and the pronounced fibroid changes of pulmonary tuberculosis as seen in man have never been observed by me in these animals. Neither do I find healed tubercular lesions in the tissues, particularly in the lungs of monkeys, as in man.

Liver: Infection of the liver by the tubercle bacillus gives rise to miliary tubercles; sometimes cheesy areas of various sizes showing extensive caseation are present. In one instance, that of an orang, I found numerous small tuberculous cavitations throughout the liver.

Kidney: Infection of the kidney by the tubercle bacillus presents the usual characteristics of miliary tuberculosis observed elsewhere. Occasionally a large portion of one kidney, or the entire organ, is converted into caseous substance.

Lymphatic Glands: Pure cases of lymphatic tuberculosis are quite common. In these instances the lymph-nodes and the spleen are the most frequent sites of the disease, the liver becoming involved later. Generally cases of lymphatic tuberculosis terminate with pulmonary involvement, though sometimes otherwise, as by tubercular meningitis.

Intestines: Ulceration of the intestines is comparatively rare, the lesions usually consisting of submucosal nodules. In some cases the large intestine is thickly studded with tubercles, while in other cases these tubercles are confined to the small intestine.

Tuberculosis among primates is preëminently a rapidly progressive disease and not a self-limiting affection. Any monkey from which tubercle bacilli are being eliminated at any time is a prolific center of infection; and the practical conclusion to be drawn is that such an animal must of

necessity be isolated from other animals the moment the existence of tuberculosis is discovered.

From our observation of this disease as seen among primates we are fully convinced that in the majority of cases the disease has been contracted before the animals reach the park; contracted under the unfavorable conditions usual in the quarters of animal dealers, or under the still more unhygienic surroundings prevailing in transit. The primary infection takes place, generally, in the cervical and bronchial lymph-nodes, and extension of the disease usually follows as metastases from these foci.

Pulmonary tuberculosis is by far the most frequent form of the disease, but other types are also observed. Several cases of typical primary intestinal tuberculosis have been met with; and pure cases of lymphatic tuberculosis are even more frequent. In these instances the lymph-nodes are the most frequent sites of the disease, the liver becoming involved later.

Generally cases of lymphatic tuberculosis terminate with pulmonary involvement, though sometimes otherwise, as by tubercular meningitis.

Since 1903 tubercular diseases among the wild animals in the New York Zoölogical Park have played a very unimportant part in the death-rate. This is due to—(1) the careful selection of the animals purchased; (2) the hygienic buildings in which they are quartered; (3) the rigorous exclusion of all animals known or suspected to be tubercular from the cages of the uninfected; and (4) at the first signs of the disease in any of the animals separating them from the healthy, the cages washed and thoroughly disinfected after the removal of such animals, and before healthy ones are placed in these compartments.

Our quarantine system, whereby all new arrivals are isolated for a short period and carefully observed before being placed on exhibition, has given excellent results. Of the nine cases of tuberculosis occurring among the primates last year, six of these died, or were destroyed, while under quarantine control, and previous to their admission to the exhibition halls. Numerous monkeys have died showing advanced pulmonary tuberculosis within a few days after their arrival. These cases were often animals that had been in captivity in private homes for some time and were received at the park as gifts.

All measures regarding sanitation, ventilation, and sunlight were matters of first consideration in the planning of the Zoölogical Park buildings, and the frequent routine and thorough disinfection of buildings, dens, and cages has been a great factor in keeping the park animals comparatively free from tuberculosis and other contagious diseases.

TABLE SHOWING THE ANATOMICAL DISTRIBUTION OF TUBERCULAR LESIONS IN ANIMALS EXAMINED IN THE NEW YORK ZOÖLOGICAL PARK DURING THE PAST SEVEN YEARS.

NUMBER OF TIMES LESIONS WERE PRESENT IN THE VARIOUS STRUCTURES.

Lungs.	Spleen.	Liver.	Kidney.	Cervical and Bronchial Lymph-nodes.	Mesenteric Lymph-nodes.	Intestine.	Meninges.	Bones.	Larynx.
107	81	64	57	74	60	19	2	2	2

Number of animals, July 1, 1908, 118.

In this list are included chimpanzees, orang-utans, and gibbons of the anthropoid apes; various old-world monkeys and baboons, as well as lemurs from Madagascar. There are 19 species represented.

La tuberculosis en los animales en cautividad.—(BLAIR.)

Mis estudios sobre tuberculosis se han limitado á los animales de la colección de primados.

Lesiones: El caracter general de las lesiones en la tuberculosis simia corresponde muy estrechamente á los de la humana, y el bacilo encontrado se asemeja también morfológicamente á los de la infección humana.

Las lesiones tuberculosas de los monos son muy extensas, prácticamente cada órgano en el tórax y el abdomen se ha encontrado invadido por la enfermadad.

Pulmones: Los pulmones están comunmente afestados por la forma de tuberculosis miliar ó nodular. La ausencia de hemorragia pulmonar en los monos, es un hecho sorprendente que se explica por el hecho de que en la forma de tuberculosis miliar la destrucción del tejido y la ulceración son muy limitadas.

Las cavidades pulmonares son excesivamente raras en los monos. Las lesiones tuberculosas crónicas son también menos frecuentes en los monos, y los pronunciados cambios fibrosos de la tuberculosis pulmonar nunca ha sido observado por mí en estos animales. Tampoco he encontrado lesiones cicatrizadas en los tejidos como en el hombre.

Hígado: La infección del hígado por el bacilo tuberculoso da lugar á tubérculos miliares, algunas veces areas caseosas de varios tamaños que muestran extensas caseificaciones. En un organután, encontré numerosas cavidades tuberculosas pequeñas á traves del hígado.

Riñones: La infección de los riñones presenta las características de la tuberculosis miliar observada dondequiera. En ocasiones una gran parte de un riñon ó el órgano entero está convertido en una sustancia caseosa.

Glándulas linfáticas: Casos claros de tuberculosis linfática son muy comunes. En estos casos los nudos linfáticos y el bazo son los sitios mas frecuentados por la enfermedad, siendo el hígado afectado más tarde.

Intestinos: La ulceración de los intestinos es relativamente rara, las lesiones comunmente consisten en nudos en la submucosa, en algunos casos el intestino grueso está repleto de tubérculos, mientras que en otros los tubérculos están limitados al intestino pequeño.

La tuberculosis entre los primados es una enfermedad rápidamente progresiva preminentemente, y no una afección limitada.

De neustras observaciones sobre esta enfermedad entre los primados, hemos sido convencidos de que en la mayoría de los casos la enfermedad ha sido contraída antes de llegar los animales al Parque. La infección de los primarios tomo lugar, generalmente, en los nudos linfáticos cervicales y bronquiales.

La tuberculosis pulmonar es con mucho la forma más frecuente de la enfermedad. Me ha encontrado con varios casos típicos de tuberculosis intestinal primitiva; y claros casos de tuberculosis linfática son aun más frecuentes.

Los casos de tuberculosis linfática generalmente terminan con una complicación pulmonar aunque algunas veces con una meningitis tuberculosa.

Las enfermedades tuberculosas entre los animales salvajes del Parque Zoologico de New York, desde 1903 juegan una parte poco importante en la proporción de la muerte. Esto se debe (1) á la cuidadosa selección de los animales comprados; (2) los higiénicos edificios en los cuales están alojados; (3) la rigurosa seclusión de todo animal que se sabe ó se sospecha estar tuberculoso, sacándolo de la jaula de los no infectados, y (4) al primer signo de enfermedad en cualquier de los animales que lo separa de los buenos, las jaulas se lavan y desinfectan completamente al cambiar dichos animales y antes de que los buenos la ocupen de nuevo.

Nuestro sistema de cuarentena, ha dado excelentes resultados. De los nueve casos de tuberculosis que ocurrieron entre los Primados el año último, seis de ellos murieron, ó fueron destruidos, mientras estaban en cuarentena, previa á su admisión en los salones de exhibición.

Todas las medidas concernientes á sanidad, ventilación y luz del sol fueron asunto de primera consideración al hacer los planos ie los edificios dal Parque Zoologico, y la frecuente rutina y completa desinfección de estos edificios; pozos y jaulas han sido un gran factor en la conservación de los animales del Parque comparativamente libres de tuberculosis y otras enfermedades contagiosas.

La Tuberculose parmi les Bêtes Fauves en Captivité.—(BLAIR.)

Lésions: Le caractère général des lésions dûes à la tuberculose simienne ressemble beaucoup à celui des lésions tuberculeuses humaines et les bacilles trouvés ressemblent aussi morphologiquement à ceux de l'infection humaine.

Les lésions tuberculeuses chez les singes sont très étendues, car presque chaque organe du thorax et de l'abdomen peut être envahi par la maladie.

Poumons: Les poumons sont d'habitude affectés par la forme miliaire de la tuberculose. L'absence d'hémorrhagies pulmonaires est remarquable, et on l'explique par le fait que, dans la tuberculose miliaire, il n'y a que très-peu de destruction du tissu et très-peu d'ulcération. Les cavernes pulmonaires sont excessivement rares chez les singes. Les lésions chroniques tuberculeuses sont aussi beaucoup plus rares chez le singe et je n' y ai jamais vu les changements fibroïdes si prononcés chez l'homme. Je n'ai pas trouvé non plus des lésions guéries, comme on en trouve chez l'homme.

Foie: L'infection tuberculeuse du foie se présente sous la forme de tubercules miliaires; quelquefois on voit des parties caséeuses de différentes grandeurs. Dans un orang, je trouvai de nombreuses cavités tuberculeuses de petites dimensions, disséminées dans le foie.

Rein: L'infection du rein présente le tableau habituel de la tuberculose miliaire, comme on l'observe dans d'autres organes. Rarement, une grande portion ou même l'organe entier est transformé en substance caséeuse.

Glandes lymphatiques: Des cas simples de tuberculose lymphatique sont très communs. Dans ces cas, les glandes lymphatiques et la rate sont les sièges les plus fréquents de la maladie; car le foie ne s'infecte que plus tard.

Intestins: L'ulcération des intestins est comparativement rare, les lésions consistant d'habitude en tubercules sous-muqueux; dans certains cas c'est le gros intestin qui est infecté de la sorte, dans d'autres cas la maladie ne dépasse pas l'intestin grêle.

La tuberculose des singes est une maladie qui fait des progrès rapides et point une affection qui s'arrête d'elle-même.

Nos observations nous ont convaincu que, dans la majorité des cas, les singes avaient contracté la maladie avant d'arriver à notre parc. L'infection primaire a lieu, en général, dans les ganglions cervicaux et bronchiques.

La tuberculose pulmonaire est de beaucoup la forme la plus fréquente de la maladie, mais on observe aussi d'autres types. On a vu quelques cas de tuberculose intestinale primaire et on rencontre encore plus souvent des cas de pure tuberculose lymphatique.

Depuis 1903, la tuberculose n' a joué qu' un rôle peu important parmi les causes de la mort des animaux sauvages entretenus dans le parc zoologique de New York. Ce fait est dû: (1) au soin qu'on met à choisir les animaux achetés, (2) à l'hygiène qui prédomine dans les bâtiments où ils sont logés,

(3) à l'exclusion rigoureuse de toutes bêtes tuberculeuses ou suspectes, des cages des animaux non-infectés, (4) aux mesures prises dès qu' un des animaux montre les premiers signes de la maladie: isolement, et puis, nettoyage et désinfection à fond des cages qui avaient appartenu à l'animal malade.

Notre système de quarantaine, par lequel tous les animaux nouvellement acquis sont isolés pour quelque temps et soigneusement observés avant de les exposer au public, a donné des résultats excellents. Sur les neuf singes qui avaient la tuberculose pendant l'année dernière, six moururent ou furent tués pendant l'isolement de la quarantaine et avant d'être admis aux salles de l'exposition.

Dans les plans de construction des bâtiments du parc zoölogique, les premières choses considérées furent les mesures hygiéniques, la ventilation, la lumière solaire. La désinfection des bâtiments et des cages, faite si fréquemment, a été le facteur le plus important qui a aidé à tenir la tuberculose et les autres maladies contagieuses loin des animaux du parc.

OBSERVATIONS UPON MONKEYS OF THE PHILADELPHIA ZOÖLOGICAL GARDEN AFTER INJECTION OF KOCH'S OLD TUBERCULIN.

By Drs. C. Y. White and Herbert Fox,
Philadelphia.

Results of Tuberculin Tests in Monkeys in the Philadelphia Zoölogical Gardens.

Introduction.—We have not thought it necessary to review the general literature on the subject of injections of tuberculin for diagnostic purposes. Much has been written on this subject in regard to both human beings and domestic animals. Comparatively little, however, have we been able to find on the use of this valuable test applied to wild animals. The opportunity has presented itself to us to follow out the test in the monkeys of the Zoölogical Gardens of Philadelphia while we were serving in the capacity of pathologists. We present in the following paper the result of our observations on tuberculin as a diagnostic agent in these animals.

The use of this test was started in 1905, and has been continued to the present. It had been noted in Philadelphia that the average life of a common monkey on exhibition varied between eighteen and twenty-one months. It has been found upon examination that the great majority of these animals died of tuberculosis. What is true in Philadelphia is likely true in the zoölogical gardens in other parts of the world. This high mortality from tuberculosis led us to adopt some measures to prevent the admission of infected animals and to isolate those already diseased. To accomplish this end the value of the tuberculin test was tried. We began this testing upon the stock of monkeys then on exhibition, but very soon found that these were in the advanced stage of tuberculosis and our results were far from satisfactory. It was decided by the officers of the Zoölogical Society that the infected stock should be destroyed, the monkey house thoroughly cleaned and disinfected, and thenceforth to place on exhibition only those monkeys which had failed to react to injections of tuberculin. All incoming monkeys were therefore placed in quarantine in the laboratory and carefully studied as to their general condition. Our observations included the state of the

gastro-intestinal tract, nervousness, thirst, coughing, and the taking of the temperature.

We encountered, as might have been expected, many difficulties in the early part of this work, chief of these being the determination of the normal temperature of the monkeys. A thorough study of the normal temperature was our first task, because at that time we had no experience or literary reference to guide us.

The normal daily temperature of the monkeys at a definite time each day was a step in the right direction, but, as will be seen later on, we soon found that even with this daily temperature, very much more was to be sought. We found that the temperature of the monkeys varied with the time of day, to a certain extent with the different species; and, furthermore, that external conditions, such as room temperature, excitation, etc., had an appreciable effect upon the record. A further study of this variation showed that the monkeys' temperature fell during the night, while the highest daily temperature was in the neighborhood of 2 to 3 P. M. In other words, the normal monkey's temperature reached the highest point between 2 and 3 P. M., with a gradual fall to its lowest level, which was about 2 or 3 A. M., and then it again rose to the afternoon height.

It was also ascertained that the normal high temperature of a healthy monkey was higher by three or four degrees than that of a normal human being. This average of temperature varied with the species of monkey under observation, but was usually in the neighborhood of 101° and 102° F. at the highest point: the lowest point in these cases was about three degrees lower, and produced, as will be seen in the charts, definite curves which we have designated as the "night drop." In order to obtain the daily curve of temperature it was found necessary to make records every four hours. By doing this, the normal temperature of a healthy monkey showed a uniform curve which reached its highest point at about 3 P. M., and the lowest level at about 3 A. M. Extensive chartings of individual monkeys and the comparison of the temperature of several monkeys showed uniform curves. The temperature was taken at 7, 11, and 3, because the high and low points were at 3 P. M. and 3 A. M. respectively. It was later found that monkeys of a nervous temperament, those easily excited, and those which failed to become accustomed to the taking of temperature showed variations in the daily curves which could be explained only by the nervous state of these animals.

Details of the Present System.—The monkeys are now received in the quarantine room of the laboratory building. The attendant who has charge of them has had many years' experience with monkeys, and is familiar with their habits. He takes a very lively interest in helping to take the temperatures and in the application of the test. The animals are allowed to remain quiet in cages for some days before observations are started. Preparatory

to the injection of tuberculin, daily temperatures are taken at 3 P. M., the hour at which the highest temperature point is reached. These daily records are continued until the temperature is seen to maintain an almost even course for about ten days. We have arbitrarily adopted 1° F. as the limit of variation during the observations previous to the injections. If this variation be in the form of a saw-tooth curve, the monkey is allowed to rest for an indefinite time until the temperature becomes more regular.

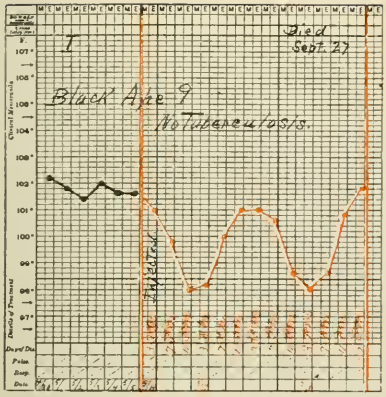
The initial record is usually high, due, no doubt, to the handling incident to the initiation of the test. After the first few days the records are lower, and follow a steadier course. The monkeys are removed from their cages with covered hands if they be small and tame, while the larger ones are caught in a net. The great majority of the monkeys readily become accustomed to this daily routine, so that by the time they are ready for the actual test little or no excitement is present. The records are made from rectal temperature in all our work. No time is lost after taking the animal from its cage in obtaining the record, so that the excitement may have as little effect as possible. The thermometer, well greased with vaselin, is inserted three inches along the anterior wall of the rectum and exposed for three minutes. If the temperature record vary several points from the previous daily record, or if there be any doubt of its correctness, it is retaken.

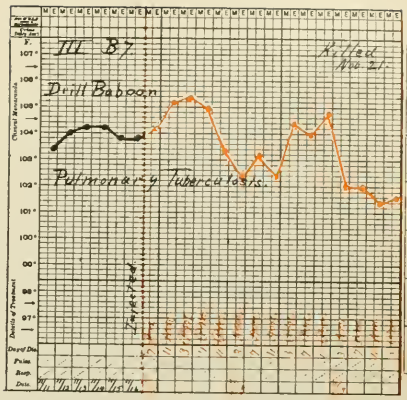
The normal height for a monkey's temperature cannot be stated with exactness compared with that of the human being. The temperature of those normal monkeys which have been killed without evidence of tuberculosis will not allow a definite statement as to the normal temperature of monkeys as a whole or of the different species. The daily temperature per rectum at 3 P. M. is most often between 101° and 102° F. Some monkeys had passed the test and still live which had an even temperature as high as 104° F. The height *per se* does not seem indicative of the condition of the monkey, unless it be quite high or low, such as 105°+ or 99°— F. These extremes are, however, usually combined with irregularity before and after the injection. Starting at the high point, 3 P. M., the temperature begins with 101° to 102° F. and gradually declines, at 7 P. M. registering 0.4° to 1° F. lower. At 11 P. M. a similar further fall is seen. The low point is reached about 3 A. M., after which a gradual rise occurs, following in reverse order the same general course as the fall during the preceding twelve hours, again reaching the high point at three in the afternoon. The average of this fall in the monkeys tested at this laboratory is 3.5° F. In a healthy monkey it may be as low as 1.8° F., or as great as 7° F. (see Chart No. 1, Black Ape, No. 9 (I.6), which shows a healthy normal four-hour temperature). The temperature of monkeys is elevated by excitement. This is well shown by Simpson and Galbraith,* who studied the temperature of normal monkeys over long

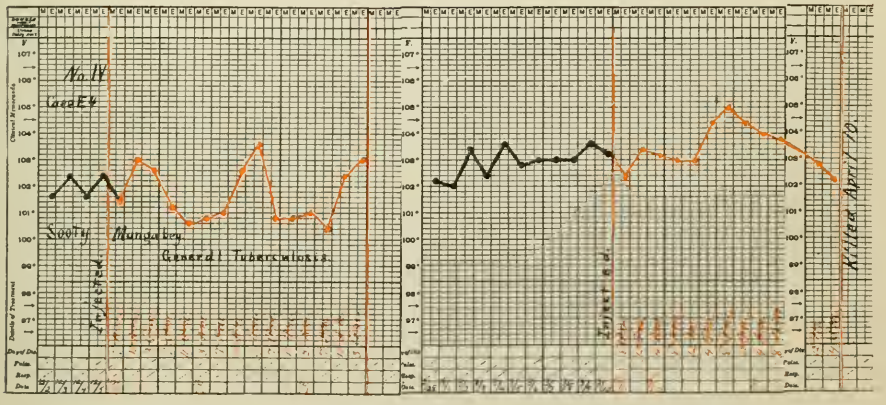
* Transactions of the Royal Society of Edinburgh, vol. xlv, p. i, p. 75, 1906.

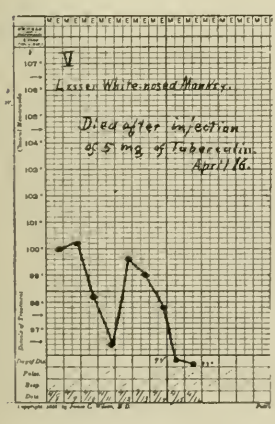
periods, and the effects of various forms of excitement. They found that the temperature was increased in direct proportion to the degree of excitement. This must be taken into consideration when observing monkeys which do not become accustomed to the excitement incident to taking the temperature. In such cases the temperature must be taken over long periods in order to obtain a definite course of the curves. Occasionally the course of the curves is so irregular that definite conclusions cannot be drawn.

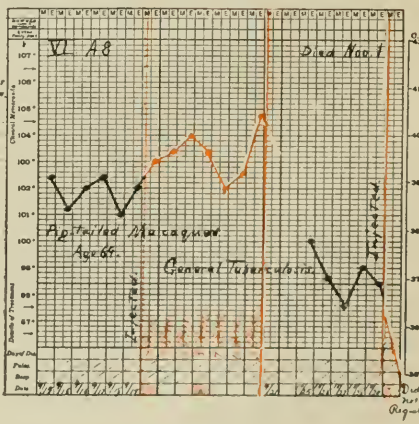
Tuberculin Test.—Preparatory to the test, the monkey is observed as above described. It has been the practice to make the injections in the forenoon to see what rise may follow at the high point on the same day. Small monkeys, such as the average common macaque, will receive 1 to 2 mg. Small capucins get $\frac{3}{4}$ to $1\frac{1}{2}$ mg.; an anubis baboon or long-armed baboon may receive as high as 3 mg. This dose is rarely exceeded. It will be seen that the dosage is higher than that usually given to human beings, but considerably lower than that given to cattle. This dose was purposely made large because in our early work we found that such doses readily caused tuberculous animals to die, while it had no effect upon healthy animals. The injection is given under the loose skin of the flank. We have never seen any local reaction at the site of inoculation. The temperature is then taken every four hours (3, 7, 11, 3, 7, 11) for forty-eight hours. In the case of a normal monkey the course of the temperature curve follows exactly that described above and illustrated by Chart No. I (I.6). In some normal monkeys a slight variation may be noted in the length of the night drop immediately following the tuberculin injection. It is frequently, but not always, 0.4° to 0.6° F. lower during the first than during the second night. This is, however, not constant or marked enough to allow any diagnostic value to be put upon it. In the case of tuberculous animals the most common occurrence is a rise of temperature within twelve hours after injection. The daily curve may be entirely destroyed, the temperature following instead a course higher than indicated by the previous daily 3 P. M. record. The destruction of the daily curve, with an elevated temperature, is the most significant indication of a positive test, *i. e.*, tuberculosis. Failure to make the normal night drop in a few cases has taught us to be always doubtful of the condition, for we have found that a subsequent test will usually give a positive reaction. In some few cases, and for reasons unknown to us, the characteristic rise indicative of a positive reaction, does not take place until some time within the second twenty-four hours. In these latter cases we generally speak of the reaction as a "delayed reaction." This delayed reaction has the usual characteristics of a positive test. Here a case may be cited in point. White-throated cebus, No. 27 (D. 7) (see Chart No. II), showed the temperature series taken many times from September, 1905, to January, 1906. The course was very irregular at first and he was not in-


I
Died Sept. 27
Black Ape 9
No Tuberculosis.
Injected


III B7
Killed Nov. 27
Drill Baboon
Pulmonary Tuberculosis.
Injected


No. IV
Case E4
Sooty Mangabey
General Tuberculosis
Injected
Injected
Killed April 10


V
Lesser White-nosed Monkey.
Died after injection of 5 mg. of Tuberculin. April 16.


VI A8
Died Nov. 1
Pigtailed Macaque.
Age 6½.
General Tuberculosis
Injected
Injected

jected until January 28, 1906. A rise of 1° F. followed the injection, but the rest of the curve was about normal. He was held over and retested March 23d, at which test the curves did not seem low enough. His temperature remained irregular during the summer while he was under observation. In November, 1906, he was tested again after a more regular period. The first day did not fall very low, but followed a regular progression until the 11 o'clock A. M. temperature on the second day, which was the high point instead of 3 P. M. There was a very irregular and shallow curve during the next twenty-four hours, and at 3 P. M. on the third day the record was 0.6° F. higher than any previous one in this course. At autopsy the only sign of tuberculosis was in the right bronchial lymph-gland, where two small progressive tubercles were found. This well illustrates the desirability of taking the temperature two days after the injection, and how minute a lesion will cause a reaction. Good charts of tuberculous monkeys after the test are seen in (B. 7 and E. 4) Charts Nos. III and IV. The temperature in advanced cases of tuberculosis may fall below the registering point of the thermometer immediately following the test. This is well illustrated by lesser white-nosed monkey (C. 2, Chart No. V) and pig-tailed macaque, No. 69 (A. 8, Chart No. VI). In both of these cases the animal died. We have occasionally noted an unusually deep night drop immediately following the injection in monkeys which were subsequently found on autopsy to be healthy. The temperature of these monkeys showed an approximately normal rhythm without a rise above the 3 P. M. high point.

The relation of the degree of reaction to the extent or severity of the lesions is a very uncertain one, and our experience allows no conclusions on this score, with the exception noted above concerning very advanced cases of tuberculosis. The case just cited (D. 7, Chart II) shows a positive reaction and only a minute trace of infection. Black ape, No. 7 Chart VII (I.2) gave a most pronounced reaction and had only a few pinhead-sized tubercles in the liver and spleen, while sooty mangabey No. 62 (E. 4), Chart IV drill, No. 5 (B.7, Chart III), gave no more marked reactions and showed advanced lesions at autopsy. Perhaps the rule is for the temperature to fall in the most active and wide-spread cases.

The number of monkeys received at the gardens and tested during the time these observations have been made is as follows: 128 monkeys received; passed, 81; condemned or died at or near the time of the first injection and not on exhibition, 47. It will be seen from this that only 63.3 per cent. of the monkeys received actually passed the tuberculin test. Of the 81 monkeys which were passed, 79 were sent to the monkey house; five died there as the result of tuberculosis. They lived one, three, eight, eight, and sixteen months. Five others were returned, retested or killed, and found tuberculous. The rest remain apparently normal to date. No monkey passed since

February, 1906, has as yet developed any sign of tuberculosis. In reviewing the charts of the monkeys dead of tuberculosis and of those associated with them in the cages, it is possible to suspect the source of infection of at least several of these animals. The total deaths from tuberculosis among monkeys which had been in the monkey house since the test was begun is ten, of which eight may with reasonable certainty be traced to two infections from cases which passed early in the tests; these temperature charts would not have been passed had we had the experience gained later. From March 1, 1907, to March 1, 1908, there were two deaths; and the last death from tuberculosis was on October 17, 1907.

The monkeys which passed the test and showed tuberculosis after being returned from the monkey house for any reason are as follows:

Sooty mangabey, No. 62, passed on forty-eight-hour temperature; returned and found tuberculous after being on exhibition three months.

Sooty mangabey, No. 63, passed on forty-eight-hour temperature; on exhibition three months; injected, gave a questionable reaction; gave a positive reaction eight months after return. The reaction on which it was passed was questionable.

Sooty mangabey, No. 60, passed on forty-eight-hour temperature which was questionable; returned in three months; eight months after return positive reaction, tuberculosis.

Grivet, No. 9, passed on questionable forty-eight-hour temperature; returned in three months; positive reaction; killed, tuberculosis.

Black ape, No. 7 (I.2), Chart VII, passed on twenty-four-hour temperature; returned in three months; gave questionable reaction; a regular daily temperature for a long time; gave a positive reaction three months after return; tuberculosis.

Monkeys dying from tuberculosis in the monkey house were as follows: Drill, No. 6, passed on good forty-eight-hour temperature, died in monkey-house eight months afterward of tuberculosis.

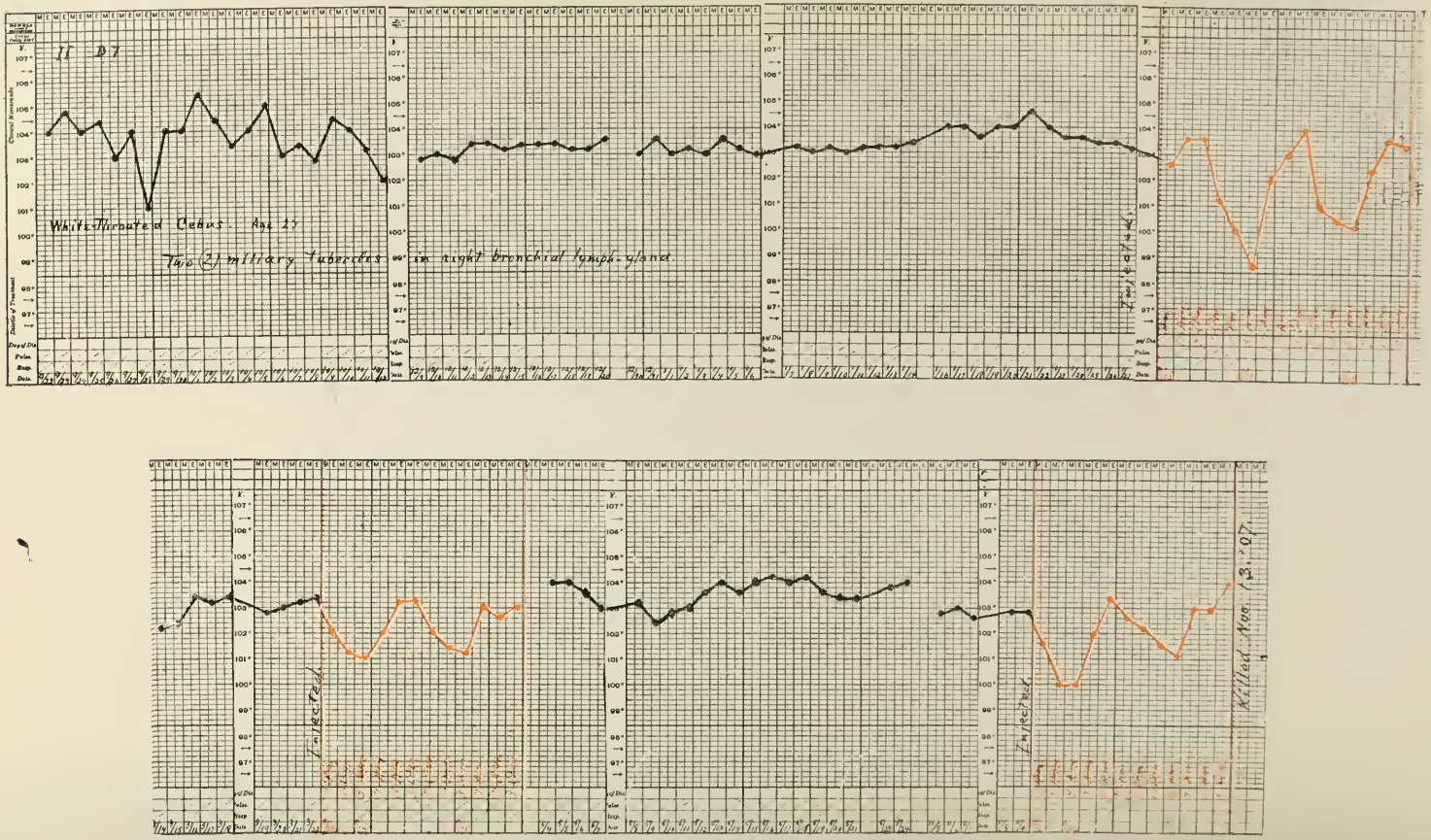
Anubis baboon, No. 34, passed on good forty-eight-hour temperature; on exhibition sixteen months; returned and killed; tuberculosis.

Common macaque, No. 205, passed on twenty-four-hour temperature; on exhibition three months; returned; irregular forty-eight-hour temperature; tuberculosis.

Sooty mangabey, No. 59, passed on good twenty-four-hour temperature; then on forty-eight-hour temperature; after twenty months on exhibition, died of tuberculosis. (Traceable to five days' exposure to sooty mangabeys, Nos. 60, 62, and 63.)

Grivet monkey, No. 8, passed on twenty-four-hour temperature; one month on exhibition; returned, tuberculous.

The following is the list of monkeys which were tested early in our work.


White Throated Celus. Age 17
Two (2) Military Tubercles in right bronchial lymph-gland.
Injected
Injected
Killed Aug. 13, '07.

Their temperature was taken after the injection for only twenty-four hours. Of these fourteen monkeys, six died of tuberculosis, some of which were included in the above lists. Seven of the fourteen were retested on the basis of a forty-eight-hour temperature after injection, and six of these were negative to the test, while the remaining one gave a positive reaction. This determined for us the necessity of taking the temperature for forty-eight hours at least following the injection.

Passed on Twenty-four-hour Temperature.

C—3, 8:15: '05,	Remaining	Retested at monkey house, forty-eight-hour temperature, passed.
A—3, 8:15: '05,	"	
B—4, 8:31: '05,	"	
B—5, 8:31: '05,	"	

Have been at the monkey house three years one month since passing twenty-four-hour test.

Died, Not Tuberculous.

B—3, Passed on twenty-four-hour temperature; retested at monkey house, forty-eight-hour temperature and passed; on exhibition two years five months; died, not tuberculous.

I—1, Passed on twenty-four-hour temperature; retested at monkey house, forty-eight-hour temperature, repassed; on exhibition one year ten months; died, not tuberculous.

I—4, Passed on twenty-four-hour temperature; on exhibition two months; died, not tuberculous.

A—26, Passed on twenty-four-hour temperature; on exhibition twenty-one days; died, not tuberculous.

Died, Tuberculous.

B—2, Tested, twenty-four-hour temperature; died, general tuberculosis.

A—2, Tested, twenty-four-hour temperature; died, general tuberculosis.

A—4, Passed, twenty-four-hour temperature; died, tuberculous.

A—6, Tested, twenty-four-hour temperature; died, general tuberculosis.

C—7, Tested, twenty-four-hour temperature; died, general tuberculosis.

I—2, Passed, twenty-four-hour temperature; retested at monkey house; returned on forty-eight-hour temperature; again tested (forty-eight hour temperature), killed; general tuberculosis.

No monkeys condemned on twenty-four-hour temperature.

Conclusions.—1. Tuberculosis is a disease which causes a considerable mortality among monkeys. The habits of the animals, moreover, facilitate the transmission when many are together on exhibition.

2. The primary object of this work was to protect the healthy monkeys by separation of the infected ones. It was therefore diagnostic work, and the use of tuberculin for therapeutic purposes was not tried.

3. It is not possible to trace the source of infection, whether from human beings or from the lower animals. From the number of monkeys that were

condemned upon the first test it was evident that a large percentage are affected while in the hands of the dealers.

4. To insure the protection afforded by the test the exhibition house must be freed of infected animals, disinfected, and only non-tuberculous monkeys admitted. The monkeys on exhibition should be retested at least once a year and doubtful animals removed from the cages.

5. To apply the test scientifically, a thorough familiarity with the normal temperature of the monkeys is necessary.

6. The normal temperature of the monkey is higher than that of the human being by 4° to 5° F. at its highest point. It follows a regular curve during the twenty-four hours, with the high point at 3 P. M., in the neighborhood of 101° to 102° F., its lowest level, about 99° F., at 3 A. M.

7. An injection of tuberculin into a non-infected monkey will not disturb this rhythm.

8. An injection of tuberculin into an infected monkey will cause a definite rise in temperature, a destruction of the daily curve, the performance of a course higher than the daily temperature at the previous high point, or any or all of these.

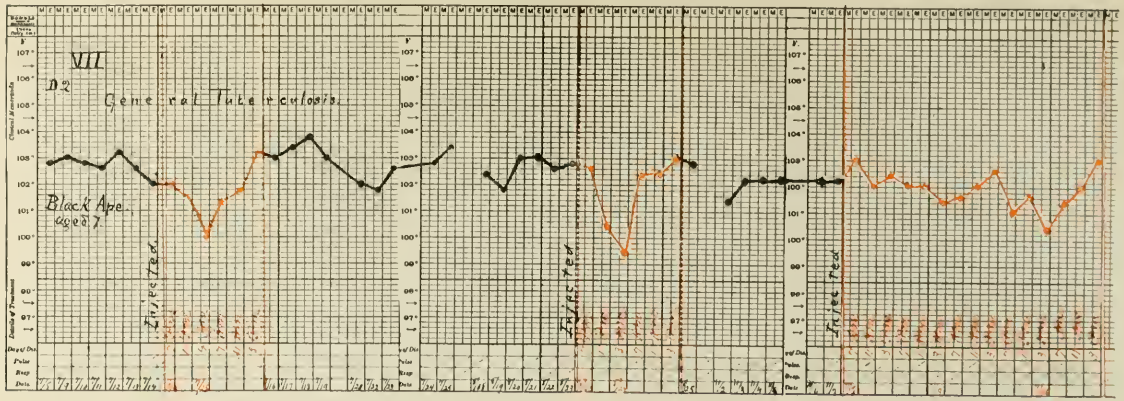
9. By the test we have been able to detect tuberculosis in 47 (37 per cent.) out of 128 monkeys tested.

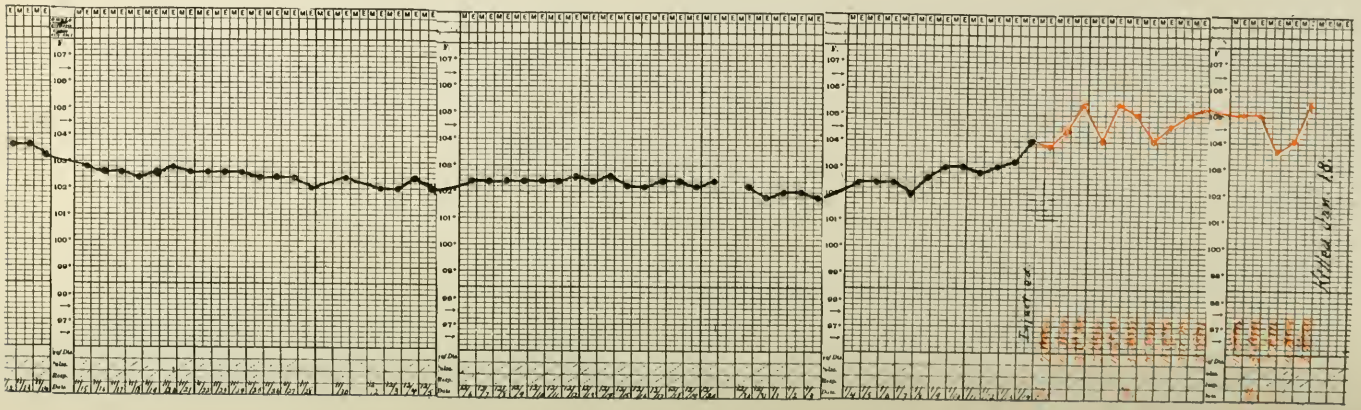
10. No monkey which has passed the test, *i. e.*, given a negative reaction, since February, 1906, has shown as yet any evidence of tuberculosis, although some have died from other causes, and others have been killed upon suspicion.

11. Ten of the 79 monkeys which were passed were subsequently found tuberculous, either in the exhibition cages or after having been returned to the laboratory for any reason. These infections are traceable to two monkeys which passed the test because of a misinterpretation of their temperature after injection during our early work.

12. By careful consideration of the temperature; by rigid adherence to hygienic measures in quarantine; and by observation of the individual peculiarities of the animals, the tuberculin test will prove an efficient means of separating infected monkeys and preserving exhibition collections.

The investigations here reported were made possible by the broad-minded interest and coöperation of the directors of the Zoölogical Society of Philadelphia, and the writers wish to acknowledge with thanks the assistance of Dr. Arthur Erwin Brown, secretary of the Society, in their work.


VII
No 2
General Tuberculosis.
Black Age
aged 7
Fever Tea
Fever Tea
Fever Tea


Fever Tea
Killed 1 Jan. 18

THE OCCURRENCE AND SIGNIFICANCE OF TUBERCLE BACILLI IN THE FECES OF TUBERCULOUS CATTLE.

By E. C. Schroeder,

Superintendent of the Experiment Station at Bethesda, Md., of the United States Bureau of Animal Industry.

Dairy products have the distinction among articles of food that they are eaten in a raw state more frequently than other substances derived from animals. In addition to this they are among the most widely used of all food products, and some of them—milk, cream, and ice-cream—are commonly eaten so shortly after they have been in contact with the animals, and the possibly infected environment of the animals, from which they are obtained that an insufficient interval of time elapses between their production and use for the disease-causing organisms with which they may have become infected to die or undergo a reduction of pathogenic virulence.

The commonest disease, alike of persons and dairy cows, is tuberculosis, and the commonest location of the disease is in the bodies of persons and dairy cows. Relative to the frequency with which persons and dairy cows are affected with tuberculosis they are more nearly alike than either is like any other animal species, though most species suffer with tuberculosis to some extent.

A proper valuation of these plain facts must engender the conviction that it is imperatively necessary for the protection of public health, in the light of our present knowledge of tuberculosis, to know how tubercle bacilli are expelled by dairy cows and how they may be introduced into dairy products. It is this conviction that serves as my reason for presenting the following paper on the occurrence and significance of tubercle bacilli in the feces of tuberculous cattle.

Microscopical examinations, supplemented by other tests, made at the experiment station of the United States Bureau of Animal Industry, demonstrated that many seemingly healthy tuberculous cattle expel virulent tubercle bacilli from their bodies per rectum with their feces.

Twelve tuberculous cows were collected from several dairy herds and kept under observation about two years. They were in excellent general condition and had no visible symptoms of disease; they were not known or sus-

pected to be tuberculous until they were tested with tuberculin, and prior to their removal from the dairy herds to which they originally belonged their milk was regularly sold to city consumers.

During the first two months microscopical examinations revealed that 5, or 41⅔ per cent., of the cows were intermittently expelling acid-fast bacilli per rectum; eighteen months later the number had increased to 10, or 83⅓ per cent.; that is, it had doubled, though the majority of the cows still retained their apparently good condition and showed no symptoms of tuberculosis.

At first it was difficult to find the bacilli in the feces; with most cows it was necessary to make daily microscopical examinations for a week or more, in one instance for several weeks, before they were found. That is to say, the intervals of time between the occurrence of the bacilli in numbers large enough to serve for their detection in the feces of individual cows were comparatively long. Later the intervals were shorter; the feces of some cows remained constantly infected, and the number of bacilli in proportion to the mass of feces was greater.

The method used in the microscopical examinations is simple. Thin films of fresh feces were spread on cover-glasses, permitted to dry thoroughly, fixed by drawing the cover-glasses through the flame of an alcohol lamp, stained with Ziehl-Neelson carbol-fuchsin, decolorized with 20 per cent. sulphuric acid, restained with Löffler's methylene-blue solution, and mounted in Canada balsam.

Microscopical examinations of the feces from a smaller number of seemingly healthy cows, of which it was known through the agency of tuberculin that they had been affected with tuberculosis three years or longer, showed that all were passing acid-fast bacilli per rectum, in most instances intermittently, but in some continuously, day after day. The same was found to be true of a small number of visibly affected tuberculous cows.

The distribution of the bacilli, as a rule, was fairly even throughout the entire mass of feces, though in advanced, long-standing cases of tuberculosis it was possible at times to pick out shreds of mucus that were very heavily infected.

As tubercle bacilli have no sufficiently marked tinctorial or microscopical peculiarities to distinguish them absolutely from all other acid-fast bacteria, it is necessary to briefly outline the evidence on which the conclusion is based that the acid-fast bacteria under consideration are certainly tubercle bacilli, and not other, less important, and possibly harmless microörganisms:

1. Numerous microscopical examinations of feces from a large number of non-tuberculous cattle, stabled, fed, etc., under practically the same conditions as those affected with tuberculosis, in no instance revealed acid-fast bacilli that could be mistaken for tubercle germs.

2. Guinea-pigs inoculated with small masses of fresh feces, from several different tuberculous cows that were passing acid-fast bacilli per rectum, as a result of the inoculations, contracted typical, generalized, fatal tuberculosis.

3. Guinea-pigs inoculated with milk carefully drawn from healthy cows in a healthy environment and afterward soiled with small masses of fresh feces from tuberculous cows that were passing acid-fast bacilli per rectum, and guinea-pigs inoculated with butter made from such milk, as a result of the inoculations became affected with typical, generalized, fatal tuberculosis.

4. A number of hogs, confined in a yard of about ½ acre area, into which the manure from a stable containing a herd of tuberculous cows was thrown, became affected with tuberculosis.

5. Several hogs, first tested with tuberculin to prove them free from tuberculosis, were fed freshly collected feces from cows that were passing acid-fast bacilli per rectum. The hogs contracted typical generalized tuberculosis. The feces for the latter test were collected while the cows were temporarily confined in a non-tuberculous environment, in narrow, high-walled stalls, and were removed from the cows immediately after they were passed. The hogs were confined in pens in which no case of spontaneous tuberculosis has ever occurred, though the same pens were used at various times for hundreds of other hogs.

6. Pure cultures of tubercle bacilli were isolated from the organs of guinea-pigs that became affected with tuberculosis as the result of inoculations with feces from cows that were passing acid-fast bacilli per rectum; and, finally, the virulence of such pure cultures was proved by inoculating cattle subcutaneously with them. The cattle became affected with typical, progressive tuberculosis, which, in one instance, terminated in death three months after the inoculation was made.

It may be interesting to know that the tuberculous lesions in the cattle inoculated subcutaneously with pure cultures of tubercle bacilli derived from bovine feces were located mainly in the lung and the thoracic lymph-glands. The lesions in the animal that succumbed three months after inoculation were most extensive in the dorsal portion of the lung, or that portion which, in cattle, relative to the regions where tuberculous processes more commonly have their beginning than elsewhere, may be compared to the apices of the human lung.

Though only a small number of cattle of which it was known that they expelled tubercle bacilli per rectum during life have been examined post-mortem, it is reasonably certain that the infection of the feces is due in most instances to pulmonary lesions that are in more or less direct communication with bronchial tubes. Several cows with heavily infected feces were affected with fairly generalized tuberculosis of the thoracic and abdominal organs, without lesions, however, of the intestinal wall or the mucosa lining the diges-

tive tract. All cows passing tubercle bacilli per rectum examined after death had pulmonary lesions from which material was being discharged into bronchial tubes. In one case the lesions were quite small and entirely confined to the lung and the thoracic lymph-glands. Among the various cattle examined, only one was found with which the infected character of the feces could doubtfully be referred to lesions of the intestinal mucosa, and even in this case it was inpossible to prove that the suspected lesions, which consisted of a few small, ulcer-like erosions on the intestinal mucosa, were certainly tuberculous. This animal was affected, in addition to the intestinal disease, with advanced generalized tuberculosis, and the condition of its lung justifies the view that a sufficiently abundant infectious material was coughed up and swallowed to thoroughly infect the entire intestinal contents.

The even distribution of the tubercle bacilli in the feces can well be explained by the long agitation and mixing to which the material that leaves the body per rectum is subjected on its way through the digestive tract, and hence this distribution is in harmony with the conclusion that the tubercle bacilli expelled in the feces commonly have their origin in the lung. This view is also supported by the following experiment: A healthy cow was given a small amount of tubercle culture in her drinking-water daily for several weeks; she was confined in a small stable which was divided into two compartments by a solid board partition; a narrow slit in the partition fitted about her neck; hence her head was in one compartment and her body in the other, so that no material could be transferred externally from her head to her body. The culture of tubercle bacilli used was of a pathogenic virulence too low to cause tuberculosis in cattle. The bacilli soon appeared in the feces, in which they were quite evenly distributed. It was proved by inoculation tests that the bacilli had undergone no determinable loss of virulence for guinea-pigs by their passage through the digestive canal of the cow.

When milk of the kind regularly sold by dealers is purchased under ordinary market conditions, and placed in the tubes of a small centrifuge, and rotated fifteen minutes at the rate of 2000 revolutions per minute, a varying amount of solid matter collects as sediment. When this sediment is examined microscopically, not more than 1 among 50 samples is found to be entirely free from particles of vegetable matter, identical in appearance with minute fragments of bovine feces. Roughly estimated, the average amount of such contamination in the market milk examined was 1 part in 4000, but some samples contained fully 1 part of cow-dung to every 400 parts of milk.

On its face this is a disgusting condition, but it is unfortunately more dangerous than its superficial appearance indicates. The solid impurities that reach the consumer in milk are often only a fraction of the total solid impurities with which it has actually been in contact. Larger masses of feces and other substances that drop into the milk-pail, or are splashed,

sprayed, or otherwise introduced into it, are removed from the milk by the straining to which it is subjected before it is poured into the containers in which it is sold. Only those solid impurities that are small enough to pass through the strainer reach the consumer.

What this means relative to the frequency with which milk will be contaminated with tubercle bacilli when it is obtained from tuberculous cows, or from healthy cows stabled and milked together with tuberculous cows, is a subject on which it is hardly necessary to enlarge, if we bear in mind in this connection that the even distribution of tubercle bacilli in the feces of tuberculous cattle signifies that each cow of average size, on the days when her feces are infected, contributes about 30 pounds of infected material to her environment.

No firm union exists between the feces of cattle and the tubercle bacilli they contain. The bacilli are present in an easily detached condition; they are too small to be strained out of milk, and they are probably washed free from the feces in milk. In a test made regarding this matter it was found, when guinea-pigs were inoculated with normal, fresh milk, to which feces from tuberculous cattle had been added, in no greater amounts than are commonly seen in unstrained dairy milk, that those among the guinea-pigs inoculated with milk after it had been strained contracted tuberculosis as frequently and succumbed as rapidly as those inoculated with the same milk before it was strained.

That the amount of foreign matter which collects as sediment in the tubes of a centrifuge cannot be regarded as a sufficient test for the amount of feces with which milk has been in contact is shown by the fact that, among the samples of milk examined relative to fecal contamination, a number were found with little or no vegetable sediment, but which yielded cream in the tubes of a centrifuge discolored precisely like the cream obtained from milk to which quite large quantities of feces were intentionally added.

Investigations made at the experiment station on the physical conduct of tubercle bacilli in milk proved conclusively that they rise with cream, irrespective of whether it is separated from milk slowly or rapidly, as freely as they sink with sediment. The coherence between cream globules and bacteria is so tenacious that it cannot be overcome by the ordinary processes to which milk is subjected. Hence, when tubercle bacilli are introduced into milk with feces the cream obtained from the milk will be infected with tubercle bacilli. Butter made from such cream will also contain tubercle bacilli; this was demonstrated by making butter from such cream and testing it with guinea-pig inoculations.

In ordinary salted butter tubercle bacilli remain alive and retain their virulence one hundred and sixty days or longer, and show no positively determinable loss of virulence in ninety days or three months. Mohler, of

the United States Bureau of Animal Industry, Division of Pathology, proved that tubercle bacilli remain alive and virulent in butter kept under ordinary commercial conditions at least one hundred and fifty-three days.

As the work of the experiment station on the long-retained virulence of tubercle bacilli in butter has been adversely criticized, from the popular point of view, because the tests were made by inoculating and not by feeding guinea-pigs, it seems worth while to record the following feeding experiment:

Four hogs, weighing about 125 pounds each, were tested with tuberculin to prove them free from tuberculosis, and were then confined in carefully disinfected pens and fed small amounts of butter made from the milk of a cow affected with udder tuberculosis. Two of the hogs were fed butter salted at the rate of one ounce of salt to the pound of butter, and two received unsalted butter. At the time the butter was fed it was three months old or older; each hog received one ounce daily, and the feeding was continued one month, so that each hog received in the course of the month, in addition to its regular food, a little less than two pounds of butter; that is, probably a smaller amount than is usually eaten by persons of the same weight.

Several months after the feeding the hogs were killed and examined postmortem, and the two that had eaten the salted, and one of the two that had eaten the unsalted, butter were found to be affected with tuberculosis. Curiously, it was one of the two hogs fed unsalted butter that remained well, and the disease was more advanced in the two hogs that received salted than in the one that became affected from the unsalted butter. This phenomenon may be explained by the assumption that the salt harmed the tubercle bacilli in the butter less by its direct action on them than it favored their preservation by retarding the growth of other bacteria.

Several hogs kept under the same conditions as the foregoing, without being fed infected butter, were found, when killed and examined after death, to be free from tuberculosis.

More conclusive evidence to show that tubercle bacilli may live and retain their virulence at least three months in salted butter would be difficult to obtain.

The various facts presented clearly seem to justify the following conclusions:

1. Tuberculous cows, wholly free from visible symptoms of tuberculosis, frequently expel tubercle bacilli from their bodies per rectum.

2. Tubercle bacilli in the feces of tuberculous cows are not dependent upon intestinal tuberculosis, but commonly have their origin in the lung.

3. Tubercle bacilli in the feces of tuberculous cows are evenly distributed throughout the entire mass, and hence the amount of infected material in the environment of tuberculous cows is very large.

4. Tubercle bacilli in the feces of tuberculous cattle are well separated

and easily detached, hence when infected feces get into milk, the bacilli are washed free from the particles of feces and remain in the milk, as they are too small to be strained out of it.

5. Since the feces of cattle are a common, almost universal, impurity in milk, the presence of tubercle bacilli in the feces of tuberculous cows makes it practically impossible to obtain milk at all times free from tubercle bacilli either from tuberculous cows or in the environment of tuberculous cattle.

6. As tubercle bacilli in milk are freely transferred to the cream separated from it, and as tubercle bacilli in cream are transferred to butter in the manufacture of which it is used, we must conclude that the presence of tubercle bacilli in the feces of tuberculous cows is an important cause for the frequent infection of all dairy products obtained from tuberculous cows or from cows exposed in the environment of tuberculous cattle.

7. As the interval of time that elapses between the production and use of milk, cream, and ice-cream is very short, and as tubercle bacilli in butter retain their virulence for long periods of time, the presence of tubercle bacilli in the feces of tuberculous cows signifies that, while we continue to use raw milk from tuberculous dairy herds, live, virulent tubercle bacilli will be distributed far and wide in a way that insures their entrance into the bodies of persons of all ages.

Now, let us bear in mind that from 15 to 30 per cent. of our dairy cows are affected with tuberculosis; that the examination of over 300 samples of milk from the local market showed that 5½ per cent., or 1 in 18, contained virulent tubercle bacilli, notwithstanding that the best available data indicate that the tuberculous condition of the local dairy herds is not as bad as that of the herds supplying milk to most other eastern cities of the United States, and certainly not as bad as the condition of the herds from which European cities obtain their dairy products, and it will become evident that the tuberculous cow is, by herself, a sufficient source of virulent tubercle bacilli to account for the infection of the whole human race.

For those who contend that tubercle bacilli from the bovine source are of no great importance for public health, I wish to direct attention to the fact that the investigations of the United States Bureau of Animal Industry alone, though they do not stand alone in this respect, supply strong evidence for the conclusion that the tubercle bacillus is a polymorphic organism, the immediate morphology of which depends upon some not yet clearly defined element in its environment.

Mohler and Washburn, of the Bureau Division of Pathology, after lengthy investigations and a careful study of the literature, concluded that the variability of the tubercle bacillus is one of its marked peculiarities. They converted tubercle bacilli from a bovine source, of the bovine morphological type, into tubercle bacilli of the morphological type known as human, by

growing them on solidified human blood-serum, and they repeatedly converted bovine types into what may be called extreme human types, by passing them through the bodies of cats.

If it is possible to convert bovine types of tubercle bacilli into human types by growing them in a test-tube on solidified human blood-serum, or by passing them through the bodies of cats, it is reasonable to assume that a similar conversion from one type to the other occurs in the human body. If this assumption is as true as it seems reasonable, the two following facts are very significant relative to the source from which the tubercle bacilli that infect persons are derived.

1. The comparatively greater frequency with which tubercle bacilli of the bovine morphological type are isolated from children, in whom the tuberculous processes are of an acute rather than a chronic character, than from adults.

2. The greater virulence of tubercle bacilli of the bovine type from bovine sources for all species of animals, including the quadrumana.

In our fight against tuberculosis we must consider all the sources from which tubercle bacilli are disseminated, and though I do not wish to give the impression that I believe the bovine source to be of more importance than the human, I am thoroughly convinced that it is one of the very important sources, and that the facts as we know them to-day warrant the following general conclusion:

It is imperatively necessary for the protection of public health that all milk should be obtained from cows certainly free from tuberculosis, and from cows stabled, milked, and pastured in an environment free from tuberculous infection, or that it should be pasteurized or sterilized before it is used as food in any form.

La Occurrencia y Significacion del Bacilo de la Tuberculosis en el Excremento del Ganado.—(SCHROEDER.)

Como 40% del ganado aparentemente en buena salud, y que se sabe que son tuberculosos por haber dado una reacción positiva á la tuberculina, intermitentemente descargan bacilo de la tuberculosis en los excrementos. Cuando un cierto numero de estos animales es guardado bajo una observacion constante el por ciento de bacilos que pasan con los excrementos es casi el doble despues de 18 meses y la frecuencia con la cual el bacilo se encuentra en el excremento del animal y el numero de ellos relativos a la masa de excremento que pasa el animal tambien aumenta. Entre 12 vacas 5, o sea $41\frac{2}{3}\%$, fueron encontradas que descargan el bacilo de la tuberculosis por el recto; gradualmente antes del termino de dos anos el numero habia aumentado a 10, o sean $83\frac{1}{3}\%$.

La prueba da que estos bacilos encontrados en el examen microscópico fueron el bacilo de la tuberculosis, se demostró por medio de las inyecciones hechas en los cobayos lo cual produjo una tuberculosis generalizada en los animales inyectados con los excrementos en los cuales se encontraron estos bacilos; tambien la tuberculosis fue producida en el cerdo cuando á estos se les alimentó con el excremento de estos animales, lo mismo la afección fue producida en los cobayos injectados con leche al cual habie sido primeramente infectada con los excrementos. Culturas del bacilo de la tuberculosis aislado de los cobayos produjo una tuberculos fatal en el ganado despues de una inoculacion subcutánea.

El examen de las leches en el mercado demuestra que esta es raramente libre de la contaminación del excremento del ganado como regla general; por lo tanto uno puede concluir que la prevalencia de la tuberculosis en las vacas lecheras y la occurrencia común del bacilo de la tuberculosis en el excremento de las vacas tuberculosas, es una prueba que el bacilo de orígen bovino, en una condicion fresca y violenta tendrá una extensa distribución y por lo tanto sobrado oportunidad para entrar en el organismo del hombre.

La presencia del bacilo de la tuberculosis en la leche significa, que ha sido demostrado en el bacilo, tambien se encuentra en la nata y en la mantequilla que se obtiene de esta leche, y tambien se ha demostrado que el bacilo de la tuberculosis retiene su violencia por largo tiempo; por lo tanto mientras que el uso de la leche cruda de las vacas tuberculosas sea usada bien como bebida ó en la forma de nata o mantequilla uno puede concluir que la predisposición de las personas á las formas violentas del bacilo de la tuberculosis de origen bovino es prácticamente universal.

Apparition et Signification des Bacilles de la Tuberculose dans les Fèces du Bétail.—(Schroeder.)

Environ 40% du bétail paraissant sains et qui sont reconnus tuberculeux seulement parce qu'ils ont réagi avec la tuberculine, laissent passer par le rectum des bacilles de la tuberculose d'une façon intermittente. Quand un certain nombre d'un tel bétail est maintenu sous une observation continuelle, on remarque que le pourcentage, de ceux qui expulsent des bacilles de la tuberculose par le rectum, double presque en 18 mois, et la fréquence avec laquelle les bacilles de la tuberculose peuvent être découverts dans les fèces de chaque animal et le nombre de bacilles relatif à la masse des fèces passées accroissent également. Parmi 12 vaches, on en a d'abord trouvé 5 ou $41\frac{2}{3}$% qui passaient des bacilles de la tuberculose par le rectum, graduellement et avant la fin de deux ans, le nombre s'était éleve à 10, ou $83\frac{1}{3}$%. Que les bacilles acid-fast, trouvés à l'examen microscopique soient réellement des

bacilles de la tuberculose, a été prouvé en ce qu'ils ont causé une tuberculose généralisée et fatale chez des cobayes qui avaient été inoculés avec des fèces, dans lesquelles se trouvaient des germes; en causant une tuberculose généralisée et fatale chez des cochons, nourris de ces fèces et en causant une tuberculose généralisée et fatale chez des cobayes, inoculés avec du lait souillé par de petites quantités de ces fèces et avec du beurre fait de ce lait souillé. Une inoculation souscutanée, fait sur du bétail, avec de pures cultures de bacilles de la tuberculose, provenant de cobayes préalablement inoculés avec des fèces, a provoqué une tuberculose fatale.

L'examen du lait commercial a démontré que des échantillons, complètement indemnes de toute contamination avec les fèces des vaches sont, en règle générale de rares exceptions. De lá, nous pouvons conclure que la grande propagation de la tuberculose parmi les vaches laitières et l'apparition fréquente des bacilles de la tuberculose dans les fèces des vaches tuberculeuses, nous nous convainquent, au moins, que les bacilles de source bovine dans une condition fraîche et virulente, auront une large distribution et d'une manière qui mène directement à leur introduction dans le corps humain.

La présence de bacilles de la tuberculose dans le lait a été démontrée de signifier qu'ils seront également présents dans la crème et dans le beurre obtenus de ce lait, il a aussi été démontré que les bacilles de la tuberculose dans le beurre retiennent leur virulence pendant de longués périodes de temp. On peut donc conclure que, pendant que l'emploi du lait cru provenant de vaches tuberculeuses ou de vaches maintenues dans un entourage tuberculeux soit comme boisson, soit comme source de crème et de beurre se continue, à peu près tout le monde est exposé aux bacilles virulents de la tuberculose de source bovine.

Vorhandensein und Bedeutung von Tuberkelbacillen im Rinderkoth.— (Schroeder.)

Ungefähr 40% anscheinend gesunder Rinder, deren Tuberkulose erst aus der Reaktion nach Tuberkulin manifest wird, setzen zeitweise mit den Fæces Tuberkelbazillen ab. Hält man eine Anzahl solcher Thiere unter constanter Beobachtung, so findet man den Prozentsatz jener, die per Rectum Tuberkelbazillen entleeren, in ungefähr 18 Monaten verdoppelt; gleichzeitig weist auch die Frequenz, mit welcher die Exkremente der einzelnen Thiere Tuberkelbazillen enthalten, sowie die verhältnissmässige Anzahl der Bazillen in einer gewissen Kothmasse eine Steigerung auf. Von 12 Kühen passirten anfänglich 5, also 41⅔%, Tuberkelbazillen per Rectum; nach und nach, innerhalb eines Zeitraumes von zwei Jahren, war die Anzahl dieser auf 10, also 83⅓%, gestiegen.

Dass die mikroskopisch nachgewiesenen säurefesten Bazillen thatsäch-

lich Tuberkelbazillen waren, wurde dadurch erwiesen, dass mit diesen bazillenhaltigen Fæces inokulirte Kaninchen, mit solchen Fæces gefütterte Schweine, sowie auch Kaninchen die mit durch geringe Kothmengen contaminirter Milch oder mit aus solcher Milch hergestellter Butter inokulirt wurden, insgesammt an allgemeiner Tuberkulose zugrunde gingen.

Aus mit solchen Fæces inokulirten Kaninchen gewonnene Reinkulturen von Tuberkelbazillen erzeugten in Rindern, wenn subkutan eingeimpft, fatale Tuberkulose.

Untersuchungen der auf den Markt gebrachten Milch erwiesen, dass Proben, die ganz frei von Contamination mit Kuhexkrementen waren, seltene Ausnahmen von der Regel bilden; es kann hieraus gefolgert werden, dass die Präponderanz von Tuberkulose in Melkkühen und das gewöhnliche Vorkommen von Tuberkelbazillen in den Exkrementen tuberkulöser Kühe zumindest so viel bewirken, dass animale Tuberkelbazillen in frischer, virulenter Form weitgehendste Verbreitung finden in einer Weise, welcher ihnen einen directen Weg zur Einführung in den menschlichen Körper eröffnet.

Das Vorhandensein von Tuberkelbazillen in der Milch garantirt erwiesenermassen dafür, das solche, auch in Sahne und Butter vorzufinden sein werden; auch ist es bekannt, dass Tuberkelbazillen in der Butter für lange Zeit virulent bleiben. Da die rohe Milch tuberkulöser Kühe oder solcher, die in tuberkulöser Umgebung gehalten werden, allgemein als Getränk oder Sahne- und Butter-Stoff benützt wird, so folgt hieraus, dass die Gefahr einer Contamination mit virulenten Rinder-Tuberkelbazillen eine tagtägliche und allgemein ist.

DISCUSSION.

Mr. Pope: I wish to call attention to the practical application of the stand taken in this paper with reference to the farmers' condition. I am surprised to learn of the great danger of milk becoming contaminated from the dirt and filth of cattle and from the careless handling of milk. How is the average American farmer to prevent exposure of his pigs and other animals? How is he to keep them from coming in contact with the disease? This is one of the points I had in mind when I spoke of the Bang system.

Dr. Bitting: I would like to modify somewhat the conclusions of Dr. Schroeder, for if the danger is as great as that indicated by the reader, not one of the workers in creameries would escape the disease. But it has been proved by my investigations of many years along this line that the disease is not more prevalent among those men than in any of the other classes.

Dr. Bebee: I wish to mention the coöperative experiments conducted with Dr. Reynolds, the results of which differ from those of Dr. Schroeder. We made microscopical examinations and inoculated guinea-pigs with the

fecal material from tuberculous cows. I believe we inoculated about 200 guinea-pigs with feces from 46 tuberculous animals. All of these animals were known to be tuberculous for two or three years before the guinea-pigs were injected. Of these animals, only one was found which excreted tubercle bacilli in the feces.

Dr. D. Arthur Hughes (Chicago): It is well known that typhoid bacilli are found in human urine, and I would like to ask Dr. Schroeder if he has conducted any experiments to determine if the urine of cattle contain tubercle bacilli.

Prof. Bang: The danger of ingesting tubercle bacilli with milk is not uniform. I want to call attention to the fact that susceptibility plays an important part in the transmission of the disease. I would also like to cite instances where avian tuberculosis was transmitted to mammals, and it is very probable that the bovine type can also be transmitted to human beings. Avian tuberculosis is considered to be very different from mammalian tuberculosis. Now, in my laboratory I, with my son, have done some experiments with feeding animals with avian tuberculosis, and we have found that cultures of avian tubercle bacilli are able to produce a bad infection of tuberculosis. At the same time, it is a very different infection. For instance, where I used a certain quantity of avian tubercle bacilli the animals died in two months. There is no doubt that bovine tuberculosis is not so different from human tuberculosis as is avian tuberculosis from mammalian tuberculosis. If avian tuberculosis is able to infect mammalia, we are obliged to think that the same would be the case with bovine tuberculosis. I would also call attention to the disease known as chronic enteritis, which is caused by an acid-fast bacillus, and in such cases the presence of the bacilli in the feces could readily be mistaken for tubercle bacilli. I would like to speak a few words regarding the presence of tubercle bacilli in the feces. This may be in many instances connected with the presence of tubercle bacilli in the milk. The investigations of Rabinowitsch show that the milk of all tuberculous animals contains tubercle bacilli, but this is not so. If the animal is not affected with open tuberculosis, there are no tubercle bacilli in the milk, and the same applies to the feces. In closed tuberculosis there are no tubercle bacilli in either the milk or in the feces. When some of the lesions open and the bacilli enter into the lymph or blood circulation, then the bacilli may be temporarily present in the milk and feces.

Prof. Heymans: The results obtained by Dr. Schroeder from the inoculation of feces into guinea-pigs are not quite conclusive. In order to prove the infectiousness of the feces for other animals inoculations should be made directly into the respective species of animals. I am inclined to doubt the possibility of tubercle bacilli in the feces being the cause of the infection of cattle and other mammals with tuberculosis. I appreciate greatly the great

work accomplished by Dr. Schroeder, and agree with him that the disease may also be transmitted to hogs by the feces of cattle, but in such cases the cattle are affected with open tuberculosis, and these cases are rare.

Dr. Peters (Nebraska): I have found that in the west tuberculosis in hogs is more frequently contracted from the infection of the fecal matter than through milk. I am unable to state whether it was open tuberculosis or not, but I can give the record of 122 farms visited. These farms were visited for the purpose of learning why tuberculosis existed in our State. The dairymen were resenting the claim that it was caused through milk, and so we found by visiting these premises that more than half of the farmers never fed milk to the hogs at all. I wish to say that probably Prof. Heymans is not acquainted with the method of feeding hogs in this country. A large proportion of the hogs follow the cattle, as our farmers believe that this is the only profitable way of raising hogs. I believe there is a great deal of danger from that source, at least we have found it so after careful examination. What is the farmer to do in all these matters? They are not disinterested. They are ready to meet every reasonable requirement. We should have the farmers' coöperation in this work, and then act with them, somewhat as boards of health make known their requirements, and try to bring them up gradually if they will come along. If we make common-sense requirements, I believe the farmers will gradually coöperate with us and meet every reasonable requirement. Furthermore, if we are to have the very best dairy products that can be produced according to modern requirements, the farmer must receive better pay for his articles. We need to go into the cities and towns and teach the city people the difference between good and bad milk.

Dr. Schroeder: The prevalence of this disease in hogs is very largely due to the mingling of hogs with tuberculous cattle. I do not know any way by which this can be prevented as long as people allow them to follow cattle that are affected with tuberculosis. I duplicated that condition at the experiment station and also exposed animals to a manure pile which contained manure from stables where tuberculous animals had been kept, with the result that all such exposed animals became infected.

With regard to creamery employees, I would state that it is generally the case that this class of men do not drink a large quantity of milk. They see too much milk, and they see how it is prepared.

Concerning the experiments of Drs. Beebe and Reynolds, I would suggest that possibly these investigations were not sufficiently searching. Dr. Rosenberger, of Jefferson Medical College, published a paper on the subject in which he found that tubercle bacilli were quite frequently present in the feces of tubercular patients. There are also numerous cases on record

in medical literature showing that the typhoid germs are frequently distributed by means of the urine.

I have made extensive investigations with reference to the elimination of tubercle bacilli. Our investigations were very careful and painstaking, our material was obtained by centrifugalization, and was examined microscopically and also by inoculation of test animals. Typhoid fever bacilli are carried in quite a different way from that of tubercle bacilli. It is supposed at the present time that typhoid bacilli are excreted through the urine, and that there is a certain amount of infection in the bladder and that the urine serves as a culture-medium for the bacilli.

I agree with Prof. Heymans that we have practically no means of distinguishing between open and closed tuberculosis. So far as the elimination of tubercle bacilli is concerned, I am in perfect accord with Prof. Heymans. Personally, I do not believe that it is a common thing for tubercle bacilli to be eliminated through the healthy organs of animals. But the elimination of tubercle bacilli in the feces makes the environment of tuberculous animals just as dangerous as the tuberculous animals themselves. It seems that we agree perfectly on this subject.

PORCINE TUBERCULOSIS.

By S. Stewart, M.D., D.V.M., and A. T. Kinsley, M.Sc., D.V.S.,
Kansas City, Mo.

Tuberculosis in swine is wide-spread among the herds of the central part of the United States, and the rapid increase in the number of hogs found to be tubercular has stimulated a careful study of the means of spread of the disease. The differences in the gross lesions found in swine and cattle has given rise to the contention that the bacillus of swine tuberculosis is not the same bacillus which produces tuberculosis in cattle. An investigation of the forms and conditions of feeding gives abundant proof that the principal source of swine infection is from tuberculous cattle. In order to make hog-raising most profitable, they are fattened in the same pens with cattle, the hogs eating the feces of the cattle, which contains a large portion of the undigested and partly digested grain. One tubercular cow or steer in a herd of 15 to 30 cattle and twice the number of hogs in a feeding pen will usually result in the infection of all the swine and part of the cattle.

If the pigs are quite young, the disease may run a rapid course and the pigs fail to grow in size and fatness, but instead become emaciated and die. If eight to twelve months old when placed in the feed lot, they have a greater resisting power, and become mature and fat even though tubercular lesions are wide-spread or generalized.

Infection evidently takes place through the mucous membrane of the alimentary tract, and in a large percentage of cases the invasion is through the mucous membrane of the mouth and pharynx, the gross lesions being confined to the related lymphatics, the submaxillary, parotid, or superior cervical glands. The invasion may occur through the intestinal mucous membrane only or simultaneously through both portions of the canal, and through either channel of entrance be carried to any part of the animal.

The gross lesions are characterized by enlargement of lymphatic glands, the formation of tubercles of variable sizes in or upon the serous surfaces and within the substance of gland organs, bones, and connective tissues. The tubercular growths give increased density to invaded soft tissues, which lead to easy detection except in case of recent invasion.

Tubercular nodules present about the same surface color as the membranes on which they develop. On cross-sections the central portion is usually caseous and slightly yellow or fibrous and nearly white, many times presenting a combination of both forms, and may contain minute calcareous particles, but rarely being liquid. The variations are believed to be due to difference in virulence of invading bacilli and tissue involved.

Pathological Histology.—The microscopical appearance of tubercular lesions of hogs has been described by several different investigators. In the examination of porcine tubercular lesions the last few years one constant variation in the structure of the tubercle has been noted. The present investigation was instituted for the purpose of confirming the findings of previous investigators and determining if there were any variations in the structure of the tubercles. The carcasses of 257 hogs were studied at the time of slaughter and notations made upon same. One specimen was obtained from each carcass for microscopical observation, and at least three sections were studied from each specimen, so that the following data are the summary of the conditions observed in 770 microscopical sections. A special card was used in recording the data. One of the cards was used for each carcass from which the samples were taken. The manner of making the notations is illustrated by the following marked card:

PORCINE TUBERCULOSIS.

Kindly answer the following as accurately and concisely as possible:

1. Number. 25.....
2. Male.....
3. Breed. *Poland China*.....
4. Condition of carcass.....good.

		CENTERS			
5. Cervical lymph-nodes.....	involved,		few,		
6. Prepectoral lymph-nodes.....	not involved,	single,	few,	many,	entire organ
7. Lung.....	not involved,	single,	few,	many,	entire organ
8. Bronchial lymph-nodes.....	not involved,	single,	few,	many,	entire organ
9. Mediastinal lymph-nodes.....	not involved,	single,	few,	many,	entire organ
10. Pleura.....	not involved,	single,	few,	many,	entire organ
11. Liver.....	involved,			many,	
12. Hepatic lymph-nodes.....	involved,			many,	
13. Spleen.....	involved,				entire organ
14. Mesenteric lymph-nodes.....	not involved,	single,	few,	many,	entire organ
15. Sublumbar lymph-nodes.....	involved,	single,			
16. Peritoneum.....	not involved,	single,	few,	many,	entire organ
17. Kidney.....	not involved,	single,	few,	many,	entire organ
18. Ovary or testicle.....	not involved,	single,	few,	many,	entire organ

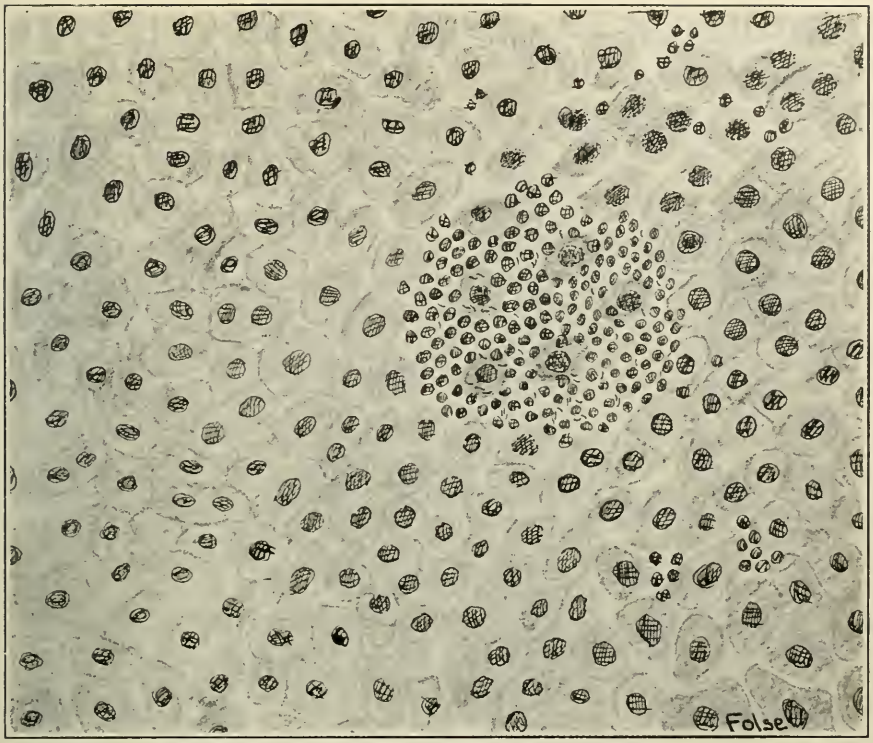


Fig. 1.—Small cellular tubercle; liver. ×500. Showing small round cells with tubercle bacilli scattered here and there, also a few partially destroyed hepatic cells.

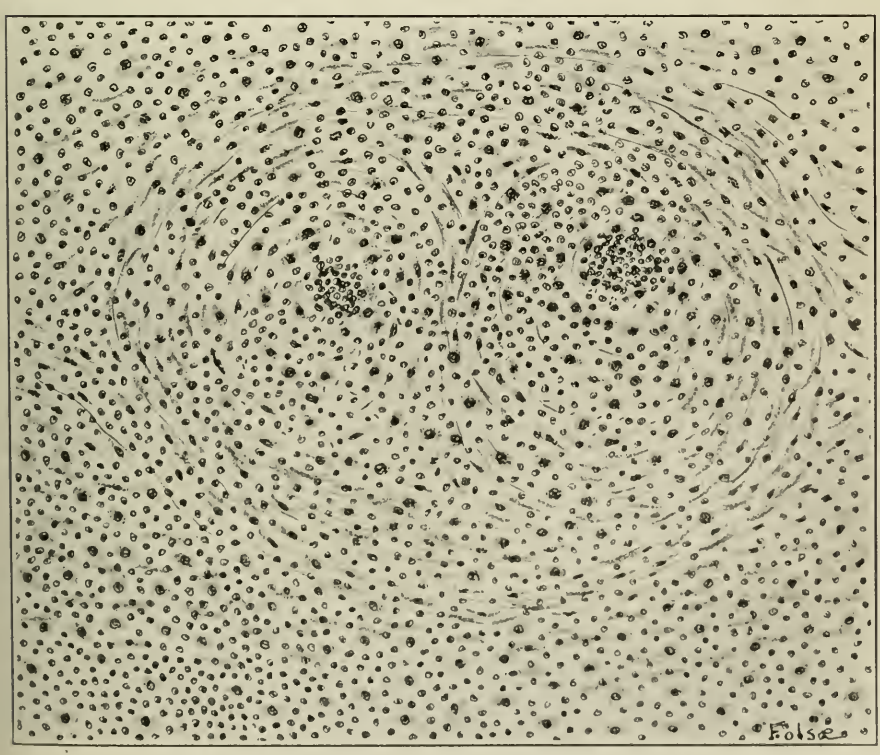


Fig. 2.—A large cellular tubercle; liver. ×250. Showing a central focus of small round cells, more or less disintegrated. Surrounding the central focus there are epithelioid cells, leukocytes, and small round cells. Peripherally there are many fibroblasts beginning to form a capsule.

PORCINE TUBERCULOSIS.—(*Continued.*)

	CENTERS
19. Uterus or penis	not involved, single, few, many, entire organ
20. Mammary gland	not involved, single, few, many, entire organ
21. Bones	not involved, single, few, many, entire organ
22. Muscular tissue	not involved, single, few, many, entire organ
23. Skin	not involved, single, few, many, entire organ
24. Condition of tubercles	calcareous
25. Sample taken from *liver*	

Sample need not be larger than a small marble.
Obtain an entire tubercle if possible.

NAME.....

The above is interpreted as follows: The notations refer to the twenty-fifth hog, male, Poland China, in fair condition; the cervical lymph-nodes contained a few tubercular centers, the liver contained many centers, etc. The lesions were calcareous, and the specimen for microscopical study was obtained from the liver.

The specimens collected for microscopical study were placed immediately in one-ounce tin boxes and labeled. The samples were placed in a 4 per cent. solution of formalin, at the laboratory, the same day that they were collected, if they were not calcareous. (The tin boxes were washed in a solution of formalin immediately after the removal of the specimen to prevent contamination of future specimens.) Calcareous specimens were decalcified in a dilute solution of nitric acid and then transferred to 4 per cent. solution of formalin. The specimens were usually left in the formalin solution for twelve to eighteen hours, and then sectioned with a freezing microtome; a few specimens were embedded in collodion and sectioned with an automatic precision microtome. The sections were cut from 8 to 14 microns in thickness. For the determination of the histological structure of the tubercle the sections were stained with hematoxylin and eosin or with hematoxylin and picrofuchsin. The following technic proved the most efficient for staining the tubercle bacilli in sections; the sections were fixed on the slides with egg-albumen and then immersed in carbolfuchsin maintained at a temperature of 36° C. for twelve to eighteen hours. The sections were decolorized and counter-stained with Gabbett's methylene-blue, after which they were dehydrated and cleared with xylol.

The lesions from the 257 cases may be grouped into five different classes, according to the condition of the tubercles, as follows:

1. *Cellular centers or tubercles:* These centers varied in size from a few

cells to masses the size of a pea. Structurally, these tubercles were fairly constant, regardless of the tissue in which they occurred, being composed of small round-cells (lymph-cells) in the smaller centers; as the tubercles become larger, epithelioid cells appear in varying numbers. The epithelioid cells were most prevalent in the central zone. The larger centers were usually limited by a peripheral zone of fibroblasts, and in some instances they were circumscribed by a dense fibrous capsule. Blood-vessels were not found in any of the tubercles. Tubercle bacilli were found in all parts of these tubercles. The accompanying illustrations (Cuts 1 and 2) demonstrate the structure of a cellular tubercle. The foregoing description is based upon the evidence obtained from the study of 31 specimens (93 sections) from 31 different hogs. The lesions were obtained from the following tissues:

Tissue	Number of Cases
Cervical lymph-node	7
Lung	3
Bronchial lymph-node	1
Liver	10
Hepatic lymph-node	4
Spleen	2
Mesenteric lymph-node	1
Kidney	2
Skin	1

2. *Necrotic centers or tubercles:* Necrosis-like fibrosis succeeds the cellular lesions in the tubercle. Necrosis in tubercles of tuberculosis is probably the result of the excessive activity of quite virulent tubercle bacilli, or the infection occurs at a time when the animal is depressed and unable to resist the invasion of the microörganisms. By reference to the records it is found that 74 per cent. of the hogs in which there were necrotic centers contained tubercular lesions in three or more different groups of lymph-nodes or organs. Histologically, necrotic tubercles are characterized by a necrotic center which may be surrounded by lymphoid cells intermingled with epithelioid cells, the entire center being surrounded by fibroblasts (Cut 3). The relative proportion of the necrotic area and various cells is dependent upon the age of the lesion. Necrotic tubercles of long standing are practically of a mass of necrotic tissue surrounded by a zone of fibroblast or fibrous connective tissue. The necrotic tissue is invariably caseated, only two tubercles having been observed in which the necrotic tissue was in a fluid state. Tubercle bacilli were found principally in the cellular areas surrounding the necrotic mass, although a few were demonstrated in the periphery of the necrotic tissue. The necrotic tubercles, like the cellular tubercles, were non-vascular. The above lesions were observed in 70 carcasses (210 sections). The specimens were obtained from the following structures:

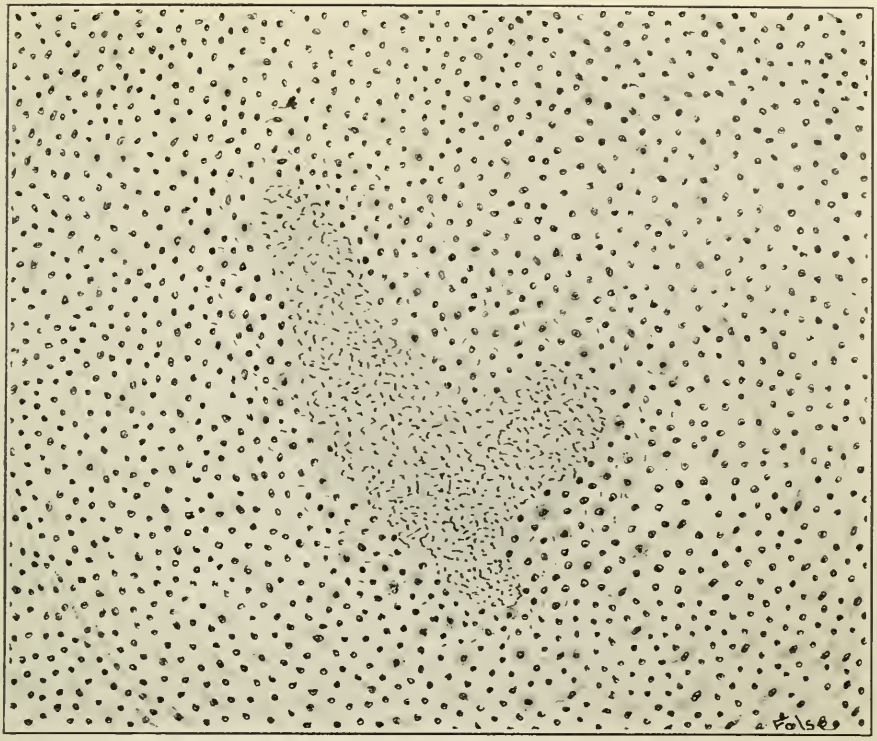


Fig. 3.—A necrotic tubercle; lung. ×250. Showing necrotic center surrounded by small round cells, epithelioid cells, and leukocytes. Many fibroblasts are evident peripherally. Tubercle bacilli evident around the margins of the necrotic center.

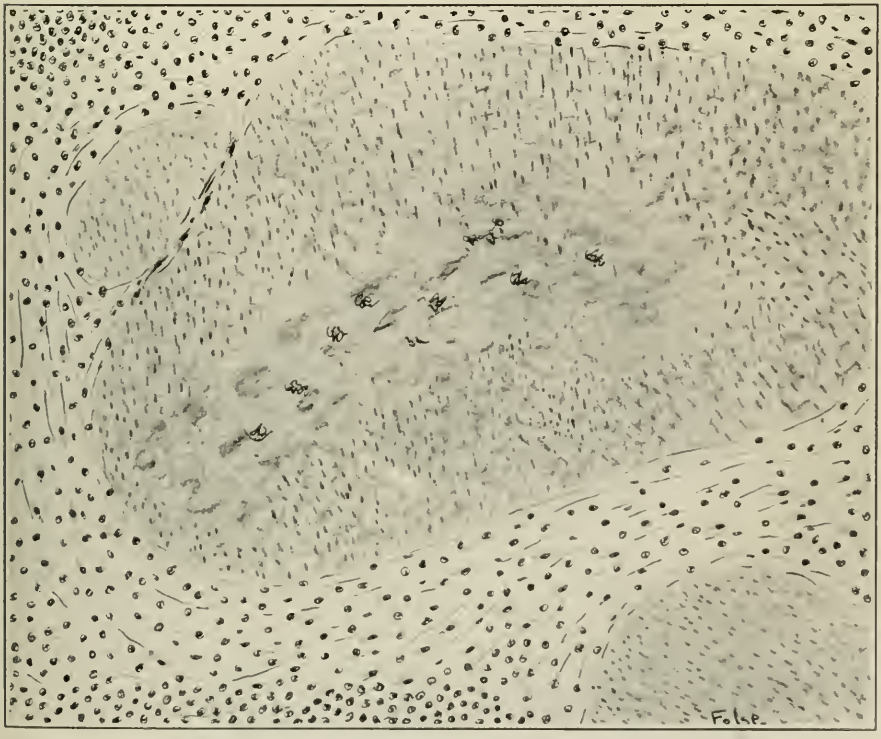


Fig. 4.—A calcified necrotic tubercle; cervical lymp-node. ×250. Showing calcareous areas in central portion of necrotic mass. The entire tubercle dis.inctly encapsulated.

Tissue	Number of Cases
Cervical lymph-node	15
Prepectoral lymph-node	1
Mesenteric lymph-node	6
Liver	1
Hepatic lymph-node	10
Lung	9
Spleen	6
Bronchial lymph-node	19
Pleura	6
Superficial inguinal lymph-node	1

3. *Calcified necrotic centers or tubercles:* These centers were identical with the lesions described in the previous paragraph, except they were of longer standing and contained calcareous deposits in the necrotic tissue; the cellular elements were inconstant, and there was usually a well-marked fibrous capsule (Cuts 4 and 5). The bacilli were found principally in the periphery of the tubercle. No vessels were observed. The above description is the summary of the study of 110 carcasses (330 sections). The specimens were obtained from the following tissues:

Tissue	Number of Cases
Cervical lymph-node	29
Prepectoral lymph-node	2
Lung	8
Bronchial lymph-node	20
Mediastinal lymph-node	2
Pleura	3
Liver	3
Hepatic lymph-node	13
Spleen	5
Mesenteric lymph-node	10
Sublumbar lymph-node	6
Bone	2
Precrural lymph-node	2
Popliteal lymph-node	1
Superficial inguinal lymph-node	4

4. *Fibrous centers or tubercles:* These lesions varied from the cellular tubercle described above to dense centers of fibrous connective tissue. They are probably the result of infection with slightly virulent tubercle bacilli, which produce a low-grade inflammation accompanied by fibrous hyperplasia. Structurally, the fibrous tubercles may consist of fibroblasts (see Cut 6) or dense fibrous connective tissue almost exclusively; a few other cellular elements, as lymphocytes and epithelioid cells, may occur in the center of the lesion. Tubercle bacilli were demonstrated in 30 per cent. of the fibrous tubercles. The description of this lesion is based upon evidence obtained in the study of 10 cases (30 sections) in which the following tissues were involved:

Tissue	Number of Cases
Cervical lymph-node	5
Lung	1
Mediastinal lymph-node	1
Spleen	2
Superficial inguinal lymph-node	1

5. *Calcified fibrous centers or tubercles:* These lesions were a later stage of the fibrous tubercles. Calcified foci were found in the central portion of the fibrous centers. Structurally, they were identical with the fibrous lesion, excepting the central calcareous foci. Only a very small percentage of these tubercles contained demonstrable tubercle bacilli. There was an occasional small blood-vessel in the periphery of the tubercles. Twenty-five carcasses (75 sections) were studied of this type of the tubercle. The specimens were obtained from the following tissues:

Tissue	Number of Cases
Cervical lymph-node	5
Prepectoral lymph-node	1
Lung	1
Bronchial lymph-node	4
Pleura	1
Liver	1
Hepatic lymph-node	2
Spleen	1
Mesenteric lymph-node	6
Sublumbar lymph-node	2
Superficial inguinal lymph-node	1

In summarizing, the lesions of porcine tuberculosis are two general types. One type is represented by the cellular necrotic and calcified necrotic tubercles. This group of lesions is probably the result of the activity of quite virulent tubercle bacilli. The second type of lesions are those described as fibrous tubercles, which may be preceded by cellular tubercles and usually contain calcareous foci in the later stages; these lesions are no doubt the result of infection with slightly virulent tubercle bacilli.

In the examination of over 770 sections, no giant-cells were observed. This may be explained by some as lack of careful observation; however, even the most careless observer would have certainly observed a few giant-cells if they are as prevalent as some investigators have indicated. The hogs from which the specimens were obtained were from Missouri, Kansas, Nebraska, and Oklahoma almost entirely; a few only were from Iowa, Wisconsin, and Illinois. Giant-cells are probably an indication of extremely virulent tubercle bacilli in bovine tuberculosis. Reaction of the tissue varies in different species of animals, and probably the reaction in the hog to tubercular infection does not stimulate the production of giant-cells.

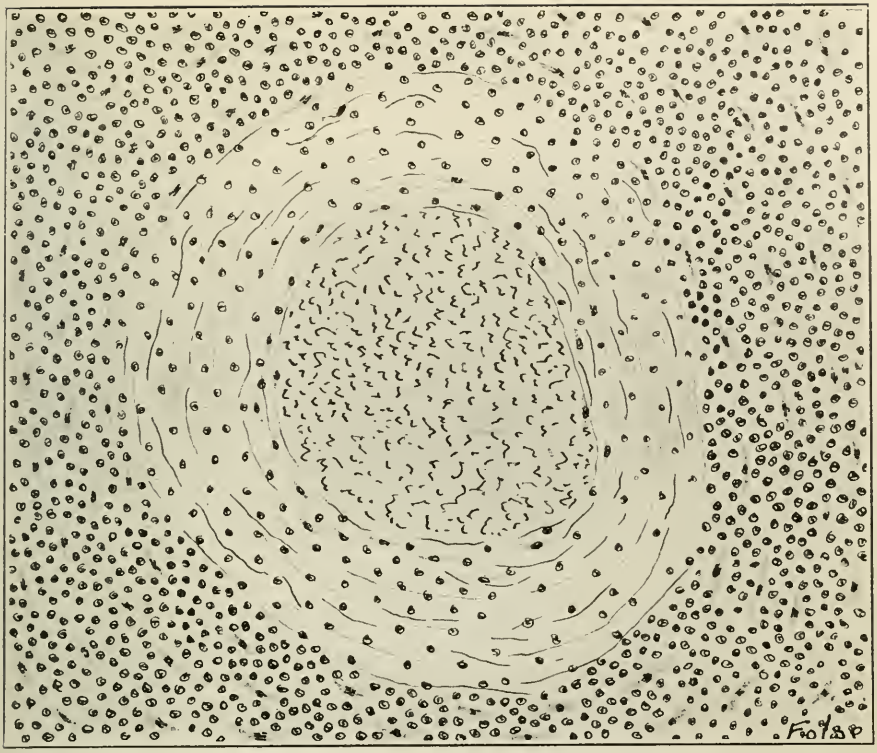


Fig. 5.—A small encapsulated tubercle; spleen. ×250. Showing capsule and necrotic center becoming calcified.

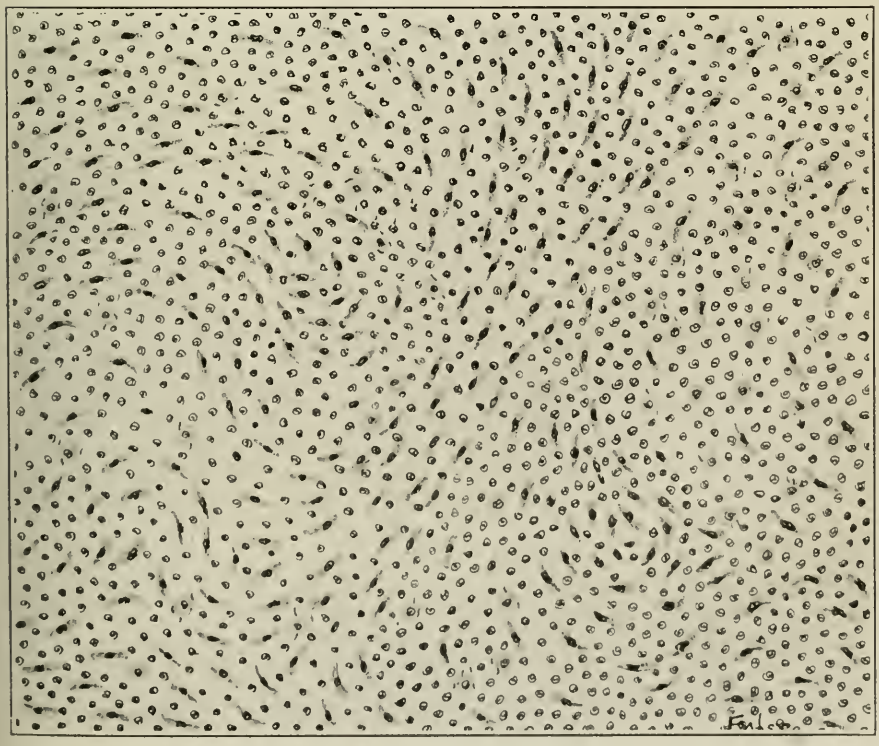


Fig. 6.—A fibrous tubercle; cervical lymph-node. ×250. Showing preponderance of fibroblasts over other types of cells and a very few tubercle bacilli.

In one section a peculiar lobulated cell was observed, and it is possible that another type of cell substitutes the giant-cell in porcine tuberculosis.

Again, it is possible that the hogs from the location described above were infected with tubercle bacilli of diminished virulence, and this is possibly the explanation of the absence of giant-cells.

The above findings confirm the fact that tubercular lesions are non-vascular; that the majority of tubercles undergo central necrosis, but that tubercles may become fibrous without necrosis, and that necrotic porcine tubercular lesions are prone to calcification.

Acknowledgment must be made to the Bureau of Animal Industry inspectors of Kansas City for assistance in the collection of specimens and data of cases, also to Mr. C. D. Folse, who ably assisted in the preparation of microscopical sections and the illustrations.

REVIEW OF RECENT INVESTIGATIONS ON TUBERCULOSIS CONDUCTED BY THE UNITED STATES BUREAU OF ANIMAL INDUSTRY.

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Introductory Remarks.

The past decade has witnessed an unusual animation among experimenters and scientists, who have been making every effort to gain a more complete knowledge of tuberculosis in all of its many phases, and as a consequence countless experiments have been instituted in each of the civilized countries in the hope of gaining a comprehensive knowledge of the character of the tubercle bacillus and a satisfactory means of combating it. Among the many who have persistently advanced in this work may be mentioned the United States Bureau of Animal Industry, and as much valuable study along various lines of animal tuberculosis has been accomplished, it was thought that a brief classified review of some of these investigations might be of interest to the members of this Congress and should be placed on record. That the Bureau is well informed on the extent of tuberculous infection of our food-producing animals is shown by the reports of its inspectors at the various packing centers, and of its agents, who are thoroughly conversant with conditions in the dairies and creameries of each of the States. It is therefore in a position to appreciate the damage which this disease causes, and to make a study of restrictive methods in their application to tuberculous patients, whether found in the human family or among the quadrupeds and birds of our farms and parks.

The Bureau has long recognized the menace which tuberculosis offers to human life and the losses which it brings to our stock-raising and dairying interests, as well as to public exhibitions of wild and rare animals and birds.

In proof of this one has only to glance over its annual reports or to notice the frequency with which the names of its members appear on index cards upon the subject of tuberculosis in the leading libraries of the world. In these investigations many animals have been studied—both those that have become tuberculous by natural infection and others that have been made tuberculous through artificial inoculation. In its laboratories cultures of tubercle bacilli are constantly growing which have been obtained from widely varied sources, and its pathological museum contains an interesting display of tuberculous lesions. At its experiment station a section including stables and yards may be seen which is entirely devoted to the keeping of tuberculous animals during the progress of experiments of immunization, infection, diagnosis, and other important questions relating to tuberculosis.

It will therefore be seen that the Bureau is well equipped for the purpose of studying tuberculosis exhaustively, and the results obtained prove the efficient use to which these equipments have been put.

In the twelfth and thirteenth annual reports of this Bureau, issued in 1895–1896,[3]* attention was first called to the fact that marked differences existed between certain cultures of mammalian tubercle bacilli. It was there shown that some cultures consisted of delicate, slender, curved individuals which possessed only a comparative degree of virulence, while others consisted mainly of short, straight members whose virulence was extreme. This was the publication which gave Koch the impetus for the work which preceded his famous address in London in 1901, and the interest thus aroused has since led to world-wide study of the questions related to tuberculosis.

Although the Bureau readily recognized the fact that differing degrees of virulence were to be found in various cultures, it could not accept Koch's theories without further study, and the biochemic division, the pathological division, and the experiment station forces were at once given instructions to take up the further investigation of this subject. It was found that the separation of tubercle bacilli into two classes, calling one "bovine" and crediting it with excessive virulence for all mammals except man; and calling the other "human," at the same time denying it the degree of virulence granted to the bovine class, and allowing it no possible part in the infection of cattle, was a measure which was not justified by actual careful experiment.

Great differences were found to exist between cultures of known bovine origin. Others identical with the bovine type in every particular were recovered from human subjects. The results obtained led to the conclusion that there existed no essential difference between tubercle bacilli derived from bovine sources and those sometimes derived from man; that there were no characters possessed by bovine tubercle bacilli which might not be possessed by tubercle bacilli of human origin; that tubercle bacilli of widely

* These numbers refer to bibliography at the end of the paper.

different virulence may be encountered in different cases of bovine as well as of human tuberculosis; that the more the subject is studied, the more numerous are the instances noted in which bacilli appear naturally in animals that are far removed from the species supposed to be their natural host, thus proving that they are not closely limited in their choice of victims and that there is no character possessed by any of these types of tubercle bacilli in one host that may not be found in another host under favoring conditions.[30]

It has been furthermore determined that the so-called typical characteristics are by no means absolute, but that under certain conditions and in certain instances they may be modified until they will assume the morphology, virulence, and cultural characteristics which are supposed to be normal to them only under very different circumstances.

This phase of the subject has been emphatically brought to our notice by close study of the characteristics of tubercle bacilli that have been recovered from tuberculous animals of various species that have died at the National Zoölogical Park. Thus on examination of two monkeys it was found that the lesions in one were due to tubercle bacilli possessing the characteristics of the bovine type, while the other one was affected, as monkeys usually are, with tubercle bacilli of the human type.

The subject of transmission of tuberculosis from tuberculous animals to man or to healthy birds or animals has received careful attention. In making investigations along this line much painstaking work has been done in making bacteriological examinations of milk, butter, cheese, creamery sediments, etc., from widely varied sources, also of dust and hay from stock stables, and of feces, urine, and saliva from tuberculous cattle. The results obtained by this line of investigation have served to point out some of the ways in which the tubercle bacillus is commonly preserved, and later transferred to some susceptible subject. This will be taken up in detail later.

The question of the possibility of the establishment of tubercular lesions in the lungs from tubercle bacilli taken into the system with the food has been carefully worked out and decided in the affirmative.[28]

Tests of the chemical reactions developed in fluid culture during the growth of tubercle bacilli have been made, it having been suggested that much could be determined by this means as to the real character of the culture. This test has not been found reliable by the bureau, as cultures known to be of bovine origin have given the acid reaction, which should only accompany cultures of human or avian origin, and a number of flasks simultaneously and similarly prepared and inoculated have been found to give differing reactions.

Much attention has also been given to comparative tests of culture-media of various kinds, and the superiority of certain media for particular lines of tubercle bacilli cultivation has been accurately determined.

The difficulty which is usually experienced in growing cultures of tubercle bacilli directly from animal tissues led the biochemic division to undertake experiments for the purpose of finding some material, readily obtainable, which would permit and encourage the growth of tubercle bacilli directly from pieces of some affected organ. The result was a preparation of eggs and glycerin, which has been found, after extensive use, to meet the requirements excellently.[16]

The addition of acid potassium phosphate to beef bouillon instead of sodium chlorid was also found to produce a more rapid and characteristic growth of cultures after they had been once recovered from tuberculous lesions.[4, 23]

The composition of tubercle bacilli when grown upon various media has been studied with reference to their mineral constituents as well as fats and volatile and non-volatile acids, and a wide variation in the chemical composition found, but no definite conclusions were drawn between the constant chemical differences of the several varieties of tubercle bacilli.[10, 11, 12, 22]

Owing to the high content of fat found in tubercle bacilli, the use of Sudan III as a staining agent suggested itself, and its use for this purpose has given satisfactory results.[14]

Considerable effort has been expended by bureau representatives in an attempt to prepare sera and attenuated cultures for the cure of tuberculosis in cattle, but thus far without success.[5,9,13] This work was taken up in connection with the preparation of tuberculin.

Immunization investigations have not been neglected. The methods devised by von Behring, Koch, and Pearson have been tried, and others offering more or less originality have been tested in comparison with these.

The result which it is most ardently desired may be derived from these laborious studies, so far as practical agricultural interests are concerned, is to have tuberculosis eradicated from our homes and farms. Attention has therefore been given to methods of disinfection, to the resistance of tubercle bacilli to various disinfectants, also to the effects of light and heat upon them and to their capacity for maintaining life while in milk, butter, and other substances.[36] The supervision of packing plants, markets, etc., from a sanitary standpoint has been carried out as an added means of eradicating sources of tubercular infection. The danger of tuberculous foods, particularly meat and milk, to the public health, has been fully realized and vigorous measures taken to prevent their distribution to unsuspecting consumers.

Having briefly outlined the various lines along which investigations into the absorbing subject of tuberculosis have been carried by the Bureau of Animal Industry, the work will be taken up in review, with closer attention to detail, although the magnitude of the subject and the number of interests involved will constantly call for condensation.

Prevalence.

Infection of cattle and hogs is most frequently seen in districts in which dairy interests are prominent, but the arid southwestern plains, and even the Pacific mountain regions, are not totally free.[29]

The records for the condemnations for tuberculosis by inspectors of the Bureau of Animal Industry, during the years 1900 to 1907 inclusive, show the following increase in percentage of the animals slaughtered under inspection.

	Cattle.	Hogs.
1900	0.089	0.0186
1901	0.10	0.035
1902	0.14	0.059
1903	0.14	0.092
1904	0.16	0.143
1905	0.18	0.256
1906	0.196	0.357
1907	0.253	0.206

The losses from tuberculosis to the farmers of this country can hardly be appreciated or calculated. There are at present approximately 19,000 carcasses of beef and 66,000 carcasses of hogs condemned annually by the inspectors of the Bureau. State dairy inspectors condemn numerous dairy cows for tuberculosis in addition to these, and many others are slaughtered at small private slaughter-houses where no record of numbers or values is kept.

The losses of small pigs on some farms, due to tuberculosis contracted from brood sows with tuberculous mammæ, or from being fed with milk containing tubercle bacilli, should not be overlooked. Breeders of pure-bred cattle are also forced to bear heavy burdens through losses of valuable breeding animals and through the disturbance of their trade with would-be purchasers living at a distance. In this connection it may be stated that the breeder of pure-bred stock who is in a position to warrant his stock as free from tuberculosis will find such a guarantee to be a valuable recommendation for his herd, and satisfactory sales will no doubt result, which could not be made from a herd in which tuberculosis was suspected.

The recent awakening of interest in the matter of obtaining pure milk-supplies for our various cities and towns has led to the application of the tuberculin test to many dairy herds. The percentage of tuberculosis detected in these cases by the use of bureau tuberculin varies from 2.79 to 19.69 in the several States. It can readily be seen, however, that these figures do not give any real indication of the prevalence of tuberculosis among our cattle, as in all probability the majority of these tests were made in herds in which the disease had already been suspected, and consequently the percentage given above is much greater than would be shown if all of the cattle of each

State were subjected to the test. An average of these extremes, or 11 per cent., would probably be more indicative of the actual extent of tuberculosis in our dairy herds.

The increasing frequency with which tuberculosis is being discovered among flocks of fowls and pigeons calls attention to another source of considerable loss through this disease. These centers of avian tubercular infection are widely separated, having been found on the Pacific coast, along the Hudson River, and at a few intermediate points.

In all of the flocks attacked and examined it has been noted that the spread of the disease among the birds has been very rapid, and so virulent has the infection in these cases proved, that only few of the individuals in the flock escape after the infection has become established. The disease is spread readily from bird to bird by way of the digestive tract, and from the well-known habit of fowls in picking their food out of dirt, and even from manure piles, it is evident the infection will be quickly taken up by the healthy members of the flock.

An interesting case is reported by one of the bureau inspectors in Oregon, who has found a ranch from which most of the fowls, and all of the turkeys, have been lost through deaths from tuberculosis, and whose swine, on reaching the abattoir for slaughter, have been found badly tuberculous. Investigations are now in progress whose purpose is the tracing, if possible, of the infection of the hogs to the eating of tuberculous fowls, or the infection of the fowls to the ingestion of tuberculous hogs, or, what would prove to be more valuable still, to trace the infection of both birds and hogs to some common source, as yet unknown. It is of interest to note that three daughters of the proprietor of this ranch have died of tuberculosis and that a son is now in the last stages of the disease.

Character and Relationship of Tubercle Bacilli.

The greatest interest attaches to the character and relationship of tubercle bacilli as found in their several hosts. This relationship between the tubercle bacilli recovered from the various species of mammals, birds, fishes, and reptiles is certainly very intimate. It may be that the slight differences which may now be demonstrated between the different types of tubercle bacilli have been of slow development, and due to their environment, to differences in the temperatures at which they have been forced to live, and to differences in the amount and quality of the nutrition with which they have been supplied.[15] Whatever the variations between the types, they are not great enough to prevent the successful interchange of tubercle bacilli by means of inoculations between representative hosts of the several types.

Recognizing the countless variations that occur in tubercle bacilli under natural conditions, the question must arise, What are the conditions that

cause some of these individuals to develop as short, plump, virulent bacilli, while others have been forced to assume long, curved, and beaded forms and to relinquish much of the virulence possessed by shorter members? It is very generally admitted that continuous artificial cultivation leads to the attenuation of these organisms. While this phase of the subject has been noted by the bureau workers, the attendant increase of adaptability to artificial conditions has not been ignored, and the causes of increased virulence, of peculiar affinities for certain species of animals, and the unaccountable appearance of certain types of tubercle bacilli in races of animals which are supposed to possess great immunity to them have also been borne in mind.

Of interest in this connection is an inspection of cultures of tubercle bacilli that have been grown in the pathological laboratory for several years either in liquid or on solid media, and that have during this period completely lost their resemblance to the type which they represented so perfectly a few years previously. Primary cultures gave no signs of growth upon culture-media until fifty-three days after inoculation. During the first month of its cultivation it was capable of causing generalized tuberculosis in guinea-pigs in from thirty-one to seventy-six days. During this period it required solid media for its propagation. Now, after fourteen years of laboratory cultivation, it will show manifest growth within thirty-six hours after planting, whether placed upon solid agar or upon glycerin-bouillon media. The mass of material which finally results from its continued growth has the appearance of a strip of thin, whitish, dry felting. The pathogenic properties of this culture have disappeared during the course of its transformation until, at the present time, the injection of guinea-pigs and rabbits with large doses will produce no visible results.

The alteration which is most noticeable in cultures of tubercle bacilli after passage through animals is either an accentuation or attenuation of virulence, with altered morphology also in evidence. Change of virulence in these cases seems to be dependent largely upon the natural susceptibility to tuberculosis of the animals injected and upon the number of tubercle bacilli used at each injection.

There is, of course, no way of determining the effect which growth within the human system would have upon bovine tubercle bacilli. So far as most investigations have been reported, there has seemed to be but slight modification evidenced in the characters of those cultures which have been assumed to be of bovine origin at the time of the isolation of the cultures, but as the usual means of judging of the type of such cultures was simply by consideration of their form, virulence, and cultural characteristics, there is no assurance that many of the other human cultures studied were not of bovine origin, but, owing to continued growth in the human system, had been

obliged to exchange their more prominent bovine characteristics for those of the human type.

The growing of tubercle bacilli upon human blood under artificial conditions should impart to the organisms some of the changed characters which growth for a similar period of time within the human body would produce; and with a view to watching the effect of such culture, human blood has been obtained in sterile test-tubes, distributed in suitable quantities, then sterilized by the fractional method, and later inoculated with cultures of bovine tubercle bacilli. The result of growth upon this human blood was that material lengthening occurred, and that beading became very general after three months' retention upon this unusual medium. The growth, however, was continued for one hundred days and more, and by this means the fact was apparently established that the introduction of bovine tubercle bacilli into conditions which must be identical, so far as chemical constituents are concerned, with those found in the human body, will not destroy them, but, on the contrary, will permit of their continued growth.

Bovine tubercle bacilli that have been grown for a like period of time upon dog serum do not show such change of form, but remain for a longer period of time short, straight, and without beading. It is probable, therefore, that the bacilli here described have assumed a more saprophytic character, and are capable of more rapid accommodation to various cultural exigencies than they were at first. In their general appearance they must now be regarded as closely allied to the type of tubercle bacilli derived from deer and cats. Owing to the limited supply of suitable human blood for the continuation of this test, the work could not be extended over as long a period of time as would otherwise have been thought desirable.

A similar lengthening of the bovine bacillus, together with an increased growth, has also been observed along the edge of a streak of paraffin on the surface of egg, serum, or agar.[24]

Viability of Tubercle Bacilli.

The length of time that tubercle bacilli will continue to live and retain their virulence while in butter and other dairy products under usual market conditions has been made a subject of extended investigation.[8,20]

In these tests butter has been made from milk that has been infected by the addition of bovine tubercle bacilli from cultures, milk soiled with feces from a tuberculous cow, and another lot has been made from milk obtained from a cow with a tuberculous udder from which tubercle bacilli were being excreted daily in great numbers. These samples of butter have been prepared in both salted and unsalted condition, and have been tested upon guinea-pigs both by feeding and inoculation tests immediately after its manu-

facture, again after keeping in cold storage for a period of ten days, and again at intervals of thirty and ninety days; and finally after six months' retention in a cold-storage plant. All of the samples that had been kept for thirty or ninety days were capable of producing fatal disease in guinea-pigs, while the unsalted sample after storage for practically six months caused slight tuberculous lesions to develop in the liver and spleen of one of the six guinea-pigs inoculated. As the butter which was made under exactly the same conditions, but to which 4 per cent. of salt was added at time of manufacture, failed to perpetuate the tubercle bacilli as long as the unsalted sample, it seems evident that the salt must have exerted some destructive influence upon the bacteria, thus causing them to disappear from the butter earlier than they did where no salt was present.[38]

The testing of feces, urine, and milk from cows known to be tuberculous has shown that many of these animals, even though presenting no external evidences of disease, constantly distribute tubercle bacilli by means of their fecal excrements. The number of cows shedding tubercle bacilli in this manner no doubt is far in excess of those producing tuberculous milk from tubercular udder lesions, and one of the greatest dangers of infection of man from tuberculous cattle may be found in this particular means of infecting milk through soiling it with feces bearing tubercle bacilli.[39]

Tubercle bacilli given to cows in their drinking-water were found to pass through their digestive tracts and appear in their excrement without having lost their power for producing tuberculous disease. This indicates that cattle with tuberculous lungs, while they do not expectorate, still scatter tubercle bacilli freely by coughing them up and then swallowing them, allowing them to mix with the ingesta.[32]

Through endeavors to trace tubercular infection of the hogs of certain localities to its source suspicion has been cast upon the skimmed milk or separator milk from public creameries, and separator sediment has been obtained from a number of such establishments and tested for the presence of tubercle bacilli. This material has been investigated by means of animal inoculations and microscopical examination, and these have demonstrated the presence of tubercle bacilli in about 25 per cent. of the samples, which shows the necessity of protecting calves and pigs from this source of infection. Through the practice of mixing all of the milk from several farms as it is separated and before the skimmed milk is distributed among the farmers to be taken back to the farm for feeding to young stock, the product of a single tuberculous herd may contaminate the entire product of the vat into which it is placed, and the infection of tuberculosis may be carried to several farms which have always up to this time been free from this disease. For this reason it behooves hog-raisers to see that their skimmed milk has been properly sterilized before they feed it, and the State authorities to make such

heating by creameries compulsory as a simple and easy way of greatly reducing swine tuberculosis.

It having been suggested that the acid-fast bacilli found in hay and about the stables may bear some relation to the tubercle bacilli found affecting animals, a number of tests have been made by injecting some of the acid-fast hay bacilli into animals. The lesions thus produced resemble closely those developed following the injection of tubercle bacilli that have been sterilized. The several foci are small and are not inclined to grow or spread. Neither do they show the amount of inflammation which is caused by virulent tubercle bacilli. From the work done in this line it has been made evident that tuberculosis of hogs and cattle is always dependent upon tubercle bacilli for its origin, and cannot be developed from the bacilli which are found in the dust of hay barns or stable floors, but must arise from a preëxisting case of the disease, whether in man or animal.

It is well known that sunlight is an efficient agent in the destruction of tubercle bacilli. Experiments have shown that tubercle bacilli when exposed in thin layers to direct sunlight will be killed in comparatively a few minutes. Tubercle bacilli in sputum or in pus from tubercular abscesses when treated in this manner will lose their vitality within two hours. This fact should be borne in mind by those who are attempting to clear any farm or stable premises of tuberculosis. Were it not for this efficiency of sunlight in destroying tubercle bacilli, one of the hardest tasks connected with the eradication of tuberculosis from the farm would be the sterilization of the infection upon the surfaces of the yards and pastures. Wherever tuberculous cattle or swine have been yarded, the spreading of great numbers of tubercle bacilli must follow. The same beneficial actions are exerted upon the infectious sputa which are scattered about the streets by careless consumptives. Reasoning from these results, no one should fear to let the sunlight into dwellings or locations inhabited by those who are affected with tuberculosis, not alone for the good of the patient, but also for the added safety of those who live with him.

Many tests have also been made for the establishment of the minimum degree of heat which will be required to destroy tubercle bacilli in fluids with a view to the application of this knowledge to the pasteurization of milk. The boiling of milk affects its digestibility, making it less suited to some stomachs and positively harmful to some children. It has been found that the tubercle bacillus has no great powers of resistance against heat, 60° C. proving quickly destructive to it. This temperature does not alter the character of the milk, and will in twenty minutes destroy all of the tubercle bacilli that may be contained in it. One-half of this exposure will in most instances prove sufficient, but there is always a chance that the utensils containing the milk and the milk itself will be cold when the pasteurization is begun,

and will thereby lower the temperature of the heating apparatus so much when placed in it that a careless operator will not thoroughly cleanse the milk from virulent organisms. Therefore twenty minutes should be insisted upon. Tuberculous meat products are carefully excluded from the trade by inspectors of the bureau, hence the danger which might accrue to the public from their consumption is obviated by the purchase of inspected meats only.

Modes of Infection.

In 1903, in one of the bureau's experiments, 7 healthy cattle and 3 tubercular cows were confined in a stable containing 10 box stalls.[21] Five of the healthy cattle and the three tubercular cows occupied different stalls each day in a rotation which exposed each of the healthy cattle equally to the 3 tubercular cows. Two of the healthy cattle occupied stalls near the center of the stable and were at no time allowed to enter other stalls or to come into closer contact with any of the other cattle.

These conditions of exposure were maintained for six months, and during this period 6 of the 7 healthy cattle contracted the disease to which they had been exposed—a fact which was fully proved by autopsies. The importance of this observation lies in the fact that it points out clearly that cattle cannot be protected from tuberculosis in stables with tuberculous cattle present, simply by the careful restriction of each animal to its own individual stall.

The tendency of the results obtained from these experiments is to point to the conclusion that the presence of tubercular cows in a dairy herd is a danger which affects not only the health of the persons who use the milk, but also the prosperity of the owner of the cattle, and consequently that it is necessary that our dairy herds should be made free from tuberculosis as soon as possible. Not only is the milk produced by tuberculous cattle capable of becoming infected with tubercle bacilli excreted from the mammary gland, as has been definitely established by several bureau investigators,[1, 2, 25] but it is also likely to become polluted with tubercle bacilli from external sources. These experiments seemed to demonstrate the fact that tubercle bacilli are apparently more numerous in the environment of tuberculous cattle than in their secretions from organs, like the udder, which have not become involved in the disease. Irrespective of the view that may be taken relative to the elimination of tubercle bacilli from the bodies of tubercular animals in their secretions from unaffected organs, it must be admitted that the chance for the introduction into these secretions, or into the secretions of healthy animals in the same environment, of infected material, such as particles of soiled forage or bedding, dust, masses of mucus which have adhered to the skin, hair, etc., is a very great danger, decidedly of too much importance to be ignored.[34] The habit which cattle have of licking each other is sufficient to account for the occurrence of tubercle bacilli in the milk of a

healthy cow into which some of her hair or scales of epidermis have fallen after she has been in contact with a cow affected with tuberculosis of the respiratory organs, while of still greater importance must be considered the possible contamination of such milk by particles of infected manure, in the form of dust, dirt, etc.

An interesting feature of one of the stable infection investigations was the fact that the cow which proved to be the most active disseminator of tubercle bacilli was not one that exhibited clinical symptoms of tuberculosis, but, on the contrary, was fat, in excellent condition, and apparently in perfect health. She was the fattest and smoothest appearing individual in a dairy herd of 20 cows, and at the conclusion of the test she was in prime beef condition.

Cattle of this kind show that it is impossible to eradicate tuberculosis from a herd without the use of tuberculin. The degree of danger offered by this type of cattle is shown by the fact that 2 of the 4 guinea-pigs which received room exposure in the stall of the cow in question became affected with tuberculosis, while none of the other guinea-pigs subjected to similar exposure with other cows of the test contracted any tubercular lesions, notwithstanding the fact that many of the other cows were weak, emaciated, affected with a cough, and were displaying other evidences of the disease.

The chief method by which the tubercle bacillus enters and obtains lodgment in the animal body is not absolutely known, however, and to-day there are two principal ideas on this subject, both of which have many adherents among leading scientists. One opinion which has been adhered to for years is that the principal mode of infection in tuberculosis is by the inhalation of bacilli-laden air, thus permitting the almost direct lodgment of tubercle bacilli within the lungs, with subsequent development of pulmonary lesions, which are generally the most pronounced alterations present. The opposite view, while admitting that pulmonary tuberculosis is by far the most common form of the disease, holds that the lungs become diseased indirectly as a result of the tubercle bacilli entering the system by the mouth (ingestion), after which they are swallowed, taken up by the intestinal lacteals without any injury to the intestinal mucous membrane, pass into the thoracic duct, thence into the venous circulation, and finally are filtered out of the blood by the lungs. That this latter opinion is correct in a great number of instances is supported by numerous careful experiments of the bureau, and is probably the chief method of infection, especially in animal tuberculosis. That other modes of entrance for the tubercle bacilli are present in addition to their entry through the digestive and respiratory tracts is evident by a study of such localized lesions as tuberculous genitals of a bull, or a local tuberculous arthritis of the hock joint, indicating respectively infection by way of the genital tract and by direct inoculation through the skin. Heredi-

tary transmission, or congenital tuberculosis in the offspring, is evidently more frequent in cattle than in man; nevertheless it must not be regarded as an important cause of the genesis of tuberculosis, but rather the exposure to infection during post-fetal life. Predisposing causes which arise from unsanitary conditions, lowered vitality, exposure, and forced development, etc., are only responsible for giving the true cause (bacillus tuberculosis) an opportunity for lodgment and development, or better facilities for propagation in case the lesions are already present.

Relation to Public Health.

The latest researches into the question of intertransmissibility of tubercle bacilli from various sources have shown that Koch's doctrine, enunciated in 1901, is not warranted.[17] Variations do occur among tubercle bacilli, as among other forms of bacteria, but they are not constant. It is well known that Koch demanded, as a criterion of the animal origin of tuberculosis observed in man, the proof that cattle when injected with human tubercle bacilli will contract tuberculosis. Decisive proofs of such infection have now been obtained not only by the German Commission on Tuberculosis which was appointed at Koch's request, but also by the Royal English Commission, besides numerous French, Dutch, English, Scandinavian, Austrian, and American investigators.[26, 33] In fact, there have been so many instances on record of bovine tubercle bacilli having been recovered from human tissues, and of instances of butchers and others receiving accidental infections of the skin directly from bovine lesions, that it appears entirely proved that man is susceptible to tuberculosis caused by bovine bacilli. While the presence of bovine tubercle bacilli in human beings is seen to be not infrequent, no definite conclusions can at present be drawn as to the extent of such infection, owing to the lack of data on the subject. But the fact that tubercle bacilli of one species may be transmitted to an animal of a different species or to man makes it apparent that any preventive methods for controlling tuberculosis, to be successful, must take into consideration all species of animals which are susceptible to tuberculosis.

Having ascertained the danger to man which tuberculous milk offers, it becomes necessary to determine if tuberculous meat contains the infectious agent, and if it can produce the disease in animals fed or injected with it. Through numerous experiments much information has been gained to the effect that meat of animals affected with generalized tuberculosis may contain virulent tubercle bacilli. In one series of tests experiment animals were fed with meats from cattle that were only affected with localized lesions of tuberculosis, and whose carcasses had been passed for food. In this series no tubercular infection could be obtained, but when the flesh from condemned cases of generalized tuberculosis was fed, numerous infections of the test

animals followed.[35] It is therefore apparent that harm may follow the ingestion of such meats by members of the human family, and for this reason it is desirable to have all products coming from animals affected with tuberculosis, as well as the slaughter and disposal of such animals, placed under the supervision of an experienced inspector, since the flesh of all tuberculous animals is not equally dangerous, and consequently there must be rational discrimination between the meat of slightly or locally diseased carcasses, the flesh from which has experimentally given negative results, and the more extensively diseased carcasses the meat from which has been proved to be infectious.

Tuberculin Test.

Although the subcutaneous tuberculin test in bovines, when correctly applied, proves reliable in about 97 per cent. of cases, there still remains a prejudice against this form of testing among the farmers and dairymen which has been difficult to overcome.[2, 6, 7, 37]

It is therefore natural that any new method which may facilitate the diagnosis of tuberculosis should be accompanied by great interest. Of the various biological methods of diagnosing tuberculosis, the greatest interest has been manifested in the last few months in the cuti-reaction of von Pirquet and the ophthalmo-reaction of Wolff-Eisner and Calmette.

The very favorable results which were reported from the application of both of the above-mentioned methods excited a great deal of interest among investigators, and soon numerous results of the experiments were published, which, however, were not uniformly favorable for either of these tests. The best results, however, were apparently obtained from the ophthalmo-reaction, and if this method should prove reliable, the simple method of its application would greatly aid in the early diagnosis of tuberculosis. Thus up to the present time the ophthalmo-tuberculin test has been principally applied to the human, especially infants, and while the results obtained in these tests are very encouraging, the reactions and failures were never, or only in the earliest instances, verified by post-mortem examination. It appears therefore desirable to test the reliability of this reaction on animals, in which the reaction may be controlled by autopsies or by the known reliability of subcutaneous tuberculin test. This has been undertaken by various investigators, including the writers, and while many of the results obtained were unsatisfactory, the general findings are somewhat encouraging. The different results which were obtained might possibly be attributed to the various preparations of tuberculin which have been employed and the different strengths in which the tuberculin was applied. The varied results thus far obtained make the reliability of the ophthalmo-tuberculin test for the diagnosis of tuberculosis in bovines questionable, and it will be necessary to perfect this method by further experiments. If this method of testing should

prove as reliable as the subcutaneous tuberculin test, it would unquestionably greatly facilitate the eradication of tuberculosis, inasmuch as the farmers and dairymen would not object to this external method of applying the test as they do to the subcutaneous tuberculin injection.

The reliability of the latter test has now been fully established, and its use upon cattle as a diagnostic agent has become quite universal. Experiments of the bureau recently made upon hogs show that tuberculin may be used upon these animals with results equal in certainty to those derived from cattle whenever they can be kept perfectly quiet during the test, but this requires considerable care and attention, making it improbable that many diagnoses of tuberculosis in hogs will be made by its use.[27]

Infection of Cattle.

The danger from tuberculosis is not confined to the dairy and farming regions of the country. It menaces the cattle on the ranges of the great plains and Rocky Mountain regions as well.[18] Heretofore it has been generally believed that the ravages of this disease were confined to cattle that pass at least a portion of the year in stables. This conclusion is now disproved by the spread of tuberculosis in Argentina, Australia, and New Zealand, where the cattle pass their entire lives in the open air, and where the climate is favorable to the cure of tuberculosis in man, as is particularly the case in parts of Australia. The disease seems to have been mainly conveyed to these ranges by pure-bred cattle that have been turned with the native cattle of the various regions for the purpose of improving the quality of the stock. Vigorous application of the tuberculin test to all improved cattle intended for range life before they are released with range animals, and the destruction of all reactors, while it will not mitigate the damage already done, will at least serve to check the constant stream of tuberculous breeding stock which is now being released upon the open pastures of the west.

In the year 1900 an inspector of the bureau was stationed in Great Britain for the purpose of applying the tuberculin test to all European cattle intended for shipment to this country for breeding purposes.[19] This step met with a great deal of opposition from all sides, but since by means of these tests 229 tuberculous cattle were prevented from coming to this country during the first two years of the enforcement of the test, the real value of the work to the stock interests of this country is at once very manifest. The facts disclosed during the early years of the enforcement of the test demonstrated very clearly that none of the regulations were unreasonable or unduly severe, but that they were necessary for the protection of the herds of the United States.

Similarly the Bureau has had occasion to tuberculin test a large number of pure-bred cattle intended for shipment to Canada, Argentina, Uruguay,

and other countries requiring such inspection of breeding cattle, and the breeders of thoroughbred cattle are at the same time being encouraged and assisted by the bureau in the work of freeing their herds from tuberculosis. Through this class of testing new centers of infection are located, advice is furnished to the breeders as to the best methods of controlling the disease, and the State authorities are notified that they may take such action as they deem advisable.

Immunization Experiments.

Some time ago reports began to reach us from Europe and this country of the successful immunization of young cattle against tuberculosis by Pearson and Gilliland, von Behring, Koch, Lignières, and other investigators. While their methods were different, their systems of operation were based upon similar processes, that is, they all injected the calves with tubercle bacilli having a low degree of virulence, using bacilli having either human or bovine origin. The differences which existed in their several methods were to be found mainly in the manner of administering the injections, and in the number of applications considered necessary for the production of adequate protection of the animal. There was also some difference in the preferred age at which the calves were to be treated.

In order that the most promising of these methods for immunizing cattle against tuberculosis might be tested, and that new and needed features might be perfected and proved, a number of calves and hogs were purchased by the bureau, and were submitted to the inoculations as recommended by the most prominent investigators, receiving differing amounts of living tubercle organisms from varied sources. Numerous check animals were also used and were submitted to the same exposure to virulent tubercle bacilli that the immunized calves and hogs with which they were grouped received. In this manner, by ultimately slaughtering both the inoculated and check animals, the amount of protection afforded by the various treatments can be accurately determined. The lot of animals showing the greatest proportion of resistant animals at the completion of this experiment will be selected as representing the most feasible and effective method of immunizing cattle and hogs against tuberculosis.

It is very desirable that perfect protection be afforded the animals, if possible, by a single inoculation of the protective virus. It is therefore one of the aims of the present work to select cultures possessing the greatest degree of virulence compatible with safety to the animals treated, and at the same time to select some part of the animal's body as the seat of the injection that is but little liable to convey the microörganisms to the glandular system, where they might readily cause the establishment of a generalized case of the very disease which it was so much desired to guard against.

These experiments in immunization are not yet completed, and no report of results can therefore be made.

Another experiment somewhat related to the immunizing tests just outlined has been undertaken, in which a number of cattle that have reacted to the tuberculin test, thus proving that they are affected with tuberculosis, have been purchased, and are being treated by various methods with living and sterilized cultures of tubercle bacilli for the purpose of perfecting, if possible, some method of treatment which will serve to check the advance of the disease.

Eradication.

Although tuberculosis is extremely insidious in its attack and may remain unsuspected for a long period of time in the body of the animal in which it has become located, it is a disease whose extension throughout a herd of animals may be prevented if careful restrictive measures are persistently applied. To control tuberculosis, however, it is necessary to thoroughly understand the nature of the disease, and to appreciate fully the more common routes by which tubercle bacilli are conveyed to the domestic animals, and also the most certain methods of detecting its presence and of removing the danger which must exist wherever tuberculous animals are found.

The application of tuberculin as a reliable diagnostic agent has made it possible to separate the tuberculous from the healthy members of the herd, and has proved to be a great assistance in the work of eradicating tuberculosis from the farm. If the cattle in a dairy herd are tested accurately once a year, and the reacting animals are at once removed and the premises then thoroughly disinfected, the stables may be successfully freed from tuberculosis. This has been accomplished at the Government Hospital for the Insane, where in the year 1900, under bureau test, 79 cows gave a decided reaction to tuberculin out of 102 tested; and also at the National Soldiers' Home, where there were 53 reactions in a herd of 63. These reactors were removed, the stables carefully renovated and disinfected, and all new cows purchased for the completion of the required quota of milk-producers were subjected to the tuberculin test before being admitted to the premises. In the succeeding years the usual dairy exigencies required the disposal of several cows annually, but all newcomers were rigidly examined to make sure that they brought with them no tubercular infection into either of these herds, which now number over 300 animals. The tuberculin test was given annual application in both herds, with the result that a few reactions occurred for about three years, since which time no cases have been detected. As tuberculosis seldom attacks the swine of a farm except through tuberculous cattle, the cleansing of the dairy herd and quarters, with proper attention to general disinfection and to the purchase of new swine, will usually result

in the disappearance of tuberculosis from among the hogs. It is manifest, from what has already been stated, that no creamery refuse should be fed to hogs under these conditions until it has been thoroughly sterilized.[31]

The States of Iowa and Minnesota have enacted laws requiring each creamery management within their jurisdictions to pasteurize all skimmed or separated milk from their establishments before returning it to the farm patrons. If similar laws could find general enforcement, tuberculosis of hogs would rapidly be diminished, as it must be conceded that the by-products of the public creameries offer at present one of the most dangerous sources of tubercular infection for these animals.

Congress has recently granted power to the Department of Agriculture to examine and report upon the results obtained from the use of various kinds of tuberculin sold in this country. This power of keeping the public informed upon the value of such an important biological product as tuberculin came none too soon, for worthless tuberculin has been found on the market, and there can be no question that many inconsistent results—results which were embarrassing to the testers, and caused dissatisfaction among the stockmen—can be explained by the inertness of certain of these products.

Since 1893 the bureau has been constantly assisting some of the States in controlling tuberculosis, preparing and distributing tuberculin to their State and municipal health authorities and sanitary officers, but during the last few years the demand has been greatly increased, 215,000 doses having been sent out in the past year.

Before adjourning last May, Congress made an appropriation of $25,000 for the study of the extent and prevalence of tuberculosis in the United States. In order to determine these facts both quickly and accurately the work will necessarily be undertaken in those States where coöperation can be obtained, not only from the standpoint of organization and funds, but also with reference to having proper laws regarding the entry of tuberculous cattle; in other words, to help those States that are endeavoring to help themselves. Already several veterinary inspectors have been stationed at important shipping points for the purpose of accommodating shippers who desire to have cattle tested which are destined for States requiring the tuberculin test certificates, and while this work at present is entirely voluntary, the establishment of a large number of such points would probably follow if more States had compulsory tuberculin test laws upon their statutes. It will therefore be seen that a constantly increasing activity relative to the suppression of tuberculosis is being manifested by the Bureau of Animal Industry, and the day is not far distant when all breeding and dairy cattle crossing State lines will be required to show a tuberculin test bill of health. If the States themselves would all obtain such laws, the enforcement of an order for the testing

of the above classes of cattle entering interstate commerce, and the appointment of veterinary tuberculin testers by the government to all the principal shipping centers, would be more likely to follow. And it would not be long before the country would be divided into districts with a chief inspector in charge, for the eradication of tuberculosis, as it is at present in the south for the repression of the fever tick, and in the west for the extermination of the cattle and sheep scab mites. The effort to control tuberculosis is a most reasonable and proper one, and if conservatively directed, should receive the support of every friend of the cattle industry.

In conclusion it may be stated that the bureau is ready to continue its investigations, that the subject of immunization and eradication will continue to receive its attention, and that its efforts for the cleansing of infected stables and localities, together with its supervision over meats and dairy products, will not be lessened in the least during coming months and years.

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Revista de las Investigaciones Recientes Hechas por el Departamento de la Industria Animal de los Estados Unidos.—(Mohler y Washburn.)

El Departamento de la Industria Animal desde su fundación se ha ocupado constantemente del problema de la tuberculosis, principalmente sobre la afección de esta enfermedad en nuestros animales domésticos, más también ha prestado atención á la íntima relación entre la tuberculosis en los animales y el hombre, tampoco se han menospreciado los peligros que el contacto del hombre con los animales tuberculosos trae consigo, lo mismo que la alimentación de leches, carnes, etc., de animales tuberculosos. Los datos demuestran que desde 1895 y 1896 se encuentran las primeras notificaciones sobre las diferentes formas del bacilo de la tuberculosis de origen bovino y humano publicadas por el departamento. En ese tiempo no se pretendió sostener que el bacilo bovino y humano eran intertransmisibles, y no fue sino hasta que esta cuestión fue presentada prominentemente ante el público en 1901, que este punto fue investigado. Este último trabajo justifica la división del bacilo de la tuberculosis "en tipos" mas tambien se probó que no hay caracteres poseidos por algunos de estos tipos del bacilo de la tuberculosis que se encuentran en unas especies, que no pueda encontrarse en otras bajos ciertos condiciones favorables.

La atención del departamento fue dirigida en los primeros años á eliminar la tuberculosis de los rebaños de lecherias del pais, y á fin de hacer esto, se vió la necesidad de tener á la disposición primera calidad de tuberculina y hacia este fin se inauguro la preparación de este producto.

Medios de culturas especiales para el crecimento estudio del bacilo de la tuberculosis fueron hechos, y se hicieron extensas investigaciones con numerosas culturas obtenidas del hombre, del ganado ó de las aves. Muchas investigaciones se han hecho en cuanto á la transmisión de la tuberculosis entre los animales por medio del contacto de estos en los establos y rebaños, también sobre el contagio en los animales sanos guardados en los establos habitados previamente por animales tuberculosos: también se han hecho experimentos para determinar la capacidad del bacilo de la mantequilla y el queso bajo las condiciones del mercado. El tiempo necesario para destruir el bacilo de la tuberculosis bajo la acción de los rayos solares, también ha recibido cuidadosos estudios.

La cuestión de la inmunidad he recibido mucha atención. Primeramente todas las tentativas para producir la inmunidad fueron basadas sobre la aplicación del suero, más las investigaciones últimas han hecho abandonar el uso del suero y la atención se ha dirigido al uso de las culturas del bacilo de la tuberculosis vivo, mas en un estado atenuado.

Con relación al estudio de la tuberculosis en los animales, y su relación con la salud pública, un ancho campo de investigaciones se ha abierto y el examen de las carnes de los animales tuberculosos, con el objeto de determinar los peligros de estos alimentos, han recibido nuestra constante atención.

Muchos informes valiosos se han adquirido por medio de averiguar el origen de los animales tuberculosos que se encuentran en los rastros, y los resultados de estos trabajos dan suficientes basas para esperar que el número de animales tuberculosos, enviados á los mercados públicos, sean muy pronto materialmente reducido, puesto que se ha encontrado que el por ciento de las haciendas envian que animales tuberculosos á los mercados centrales es comparativamente poco.

Revue d'investigations récentes sur la tuberculose faites par le Bureau de l'Industrie animale des États-Unis.—(MOHLER ET WASHBURN.)

Depuis son organisation, le Bureau de l'industrie animale débat constamment des problèmes présentés par la tuberculose, surtout en ce qui touche nos animaux domestiques, mais jamais il n'a oublié l'intime parenté entre la tuberculose chez les animaux et la tuberculose chez les hommes, ni le danger qui menace l'humanité par le contact avec les animaux, et par le lait et la viande tuberculeux. Les archives du bureau montrent que la première notice donnée au public de la possession de caractéristiques différentes par les bacilles tuberculeux de sources humaines et bovines parut dans les rapports du bureau pour 1895 et 1896. Aucun effort n'a été fait, alors, pour pretendre que les bacilles tuberculeux humains et bovins n'étaient pas intertransmissibles, et c'est seulement quand cette idée à été soulevée avec éclat devant le public, en 1901, que d'autres investigations ont été faites. Ce dernier travail a justifié la division des bacilles tuberculeux en types, mais il a aussi prouvé qu'il n'y a pas de caractère possédé par n'importe lequel de ces types dans une foule qui ne puisse se retrouver dans une autre foule dans des conditions favorables.

Pendant ces premières années, l'attention du bureau a été dirigée sur la nécessité d'extirper la tuberculose des troupeaux du pays; pour faire cela on a inauguré la manufacture d'une tuberculine modèle et sûre.

Des milieux spéciaux de culture pour la croissance et l'étude des bacilles

tuberculeux ont été préparés et des recherches considérables ont été faites avec de nombreuses cultures fournies par l'homme, le bétail et l'oiseau. De grandes recherches ont été faites sur les méthodes par lesquelles la tuberculose peut être communiquée d'animaux à animaux par contact direct ou par le contact de l'étable ou étaient des animaux tuberculeux. D'autres essais ont été faits pour déterminer combien de temps les bacilles tuberculeux peuvent garder leur virulence dans du fromage ou dans du beurre, et le temps d'exposition au soleil nécessaire pour detruire les bacilles.

La question d'immunité a reçu beaucoup d'attention. Dabord tout essai de production d'immunité était basé sur l'application du sérum, mais des chercheurs plus modernes ont abandonné le sérum et l'attention se porte surtout sur l'emploi de cultures vivantes, mais attenuées, de bacilles tuberculeux.

L'étude des rapports de la tuberculose animale avec la santé publique a ouvert un vaste champ d'investigation et l'on s'est adonné soigneusement à l'examen de la viande d'animaux tuberculeux pour savoir le degré de mal qu'elle peut faire comme nourriture.

On a obtenu beaucoup de renseignements précieux en suivant la trace des animaux tuberculeux depuis l'abattoir jusqu'aux fermes d'où ils ont été envoyés, et les registres de ce travail donnent l'espoir que le nombre des animaux tuberculeux envoyés aux marchés sera bientôt réduit, et on a trouvé que le pour cent de fermes qui envoient des animaux tuberculeux aux grandes marchés est comparativement petit.

Übersicht von neuerlichen Untersuchungen über Tuberkulose, ausgeführt von The United States Bureau of Animal Industry.—

(Mohler und Washburn.)

Seit seiner Gründung ist das Bureau of Animal Industry ständig mit den Tuberkulose-Problemen im Kampfe gelegen, besonders in Bezug wie diese Krankheit unsere Haustiere angreift, aber zu keiner Zeit hat es das intime Verhältnis zwischen der Tuberkulose in den Tieren und der Tuberkulose in dem Menschen vergessen; auch ist die Gefahr, welche die Menschheit durch Berührung mit tuberkulösen Tieren und durch den Genuss von tuberkulöser Milch oder tuberkulösem Fleische droht, niemals vernachlässigt worden.

Aus den Berichten der Vergangenheit, die dieses Werk des Bureaus in Bezug auf die Forschungen in diesem Gegenstande decken, kann man sehen, dass die erste Notiz, welche das Publikum jemals von der Verschiedenheit von Eigenschaften der Tuberkelbazillen des Rindes von denen des Menschen

erhielt, in den Bureau-Berichten der Jahre 1895 und 1896 erschien. Zu jener Zeit wurde kein Versuch einer Behauptung gemacht, dass die Tuberkelbazillen vom Menschen und vom Rinde nicht leicht übertragbar wären, und nur wenn im Jahre 1901 die Sache in hervorragender Weise vor das Publikum gebracht wurde, wurde der Gegenstand wieder aufgenommen und weiteren Forschungen das Wort geredet. Diese spätere Arbeit rechtfertigt die Einteilung von Tuberkelbazillen in "Typen," aber es wurde auch bewiesen dass es, keine Eigenschaft giebt, die in einem der Typen der Tuberkelbazillen ist, dass sie nicht auch in einem anderen Typus unter günstigen Umständen gefunden werden könnte.

Die Aufmerksamkeit des Bureaus wurde in seinen frühen Jahren des Bestehens auf die Wünschenswertigkeit der Ausrottung der Tuberkulose aus den Milchherden des Landes gelenkt, und um dieses zu thun, wurde auf die Nothwendigkeit eines gleichmässigen und verlässlichen Tuberkulins hingewiesen, und die Herstellung dieses Produktes wurde angefangen.

Besondere Kulturmedien für die Zucht und das Studium von Tuberkelbazillen wurden später zubereitet, und umfangreiche Untersuchungen wurden mit zahlreichen Kulturen gemacht, die von dem Menschen, dem Rinde und von Vögeln erlangt worden waren. Weitverbreitete Forschungen wurden gemacht über die Methode, durch welche die Tuberkulose von einem Tiere zum andern mittelst Berührung in den Ställen und Höfen, und auch durch die Berührung mit Stallutensilien in Ställen, in denen vorher tuberkulöse Tiere gelebt haben, übertragen werden könnte. Sehr eng verbunden mit diesen Proben sind auch die für die Bestimmung der Länge der Zeit, während welcher die Tuberkelbazillen ihre Virulenz beibehalten, während sie in der Butter und dem Käse unter gewöhnlichen Marktverhältnissen sich aufhalten. Die Länge der Zeit, in der die Tuberkelbazillen dem Sonnenlicht ausgesetzt sein müssen, um vernichtet zu werden, ist ebenfalls in das Gebiet der sorgsamen Forschung gezogen worden.

Auch die Frage der Immunisierung hat grosse Aufmerksamkeit auf sich gelenkt. Zuerst gründeten sich alle Versuche zur Hervorbringung der Immunität auf die Anwendung von Serum, aber spätere Studien haben den Gebrauch von Serum unterlassen, und die Aufmerksamkeit wurde hauptsächlich dem Gebrauche von lebenden aber abgeschwächten Kulturen von Tuberkelbazillen zugewandt.

Mit dem Studium der Beziehung der Tuberkulose in Tieren zur öffentlichen Gesundheitslehre hat sich ein weites Forschungsgebiet eröffnet, und man verharrte bei der Untersuchung von Fleisch von tuberkulösen Tieren mit dem Zwecke, den Grad der Schädlichkeit als ein Nahrungsmittel festzustellen.

Viel Auskunft wichtiger Natur wurde erhalten, indem man tuberkulösen Tieren von den Schlachthäusern zurück zur Farm, von der sie gesandt

worden waren, nachspürte; die Berichte dieses Werkes geben zur Hoffnung Veranlassung, dass die Anzahl von tuberkulösen Tieren, die zum Verkaufe gebracht werden, bald sich wesentlich verringere, da man gefunden hat, dass der Prozentsatz der Firmen, die tuberkulöses Material zu Markte schicken, verhältnismässig niedrig ist.

Before declaring the Section adjourned, the president announced that the afternoon session would be held in the Assembly Hall, and would be a joint session with Section I, to discuss—

THE RELATIONS BETWEEN TUBERCULOSIS OF ANIMALS AND OF MAN.

Joint Session of Sections I and VII.

The Joint Session of Sections I and VII was called to order, in the Assembly Hall, at half past two o'clock, Wednesday afternoon, September 30th, by Dr. William H. Welch, president of Section I. Dr. Leonard Pearson, president of Section VII; Prof. Robert Koch, of Berlin; Prof. J. George Adami, of Montreal, were on the platform. Dr. Welch announced the subject of the joint discussion, "The Relations of Human and Bovine Tuberculosis," and called on Prof. Robert Koch to open the discussion.

THE RELATION OF HUMAN AND BOVINE TUBERCULOSIS.

By Prof. Robert Koch,
Berlin.

The question whether or not human and bovine tuberculosis are identical is indeed of high theoretical interest. But the practical importance of the question which concerns the prevention of tuberculosis is of far greater importance. For this reason I will confine myself solely to a consideration of the practical side of the subject.

To Theobald Smith, of Harvard, belongs the credit of having been the first to call attention to certain differences between the tubercle bacilli found in man and in cattle. It was his work which induced me to take up this same study. In coöperation with Schütz, I have undertaken a series of experiments for which we selected cattle, these animals being specially suited for such work.

The results of these experiments have led me to conclusions which I have first communicated to the British Congress on Tuberculosis in 1901. They are in substance as follows:

1. The tubercle bacilli of bovine tuberculosis are different from those of human tuberculosis.

2. Human beings may be infected by bovine tubercle bacilli, but serious diseases from this cause occur very rarely.

3. Preventive measures against tuberculosis should therefore be directed primarily against the propagation of human tubercle bacilli.

I did not expect that my personal views on the relation of human and bovine tuberculosis would be accepted as final, but I have asked that the experiments of Schütz and myself be repeated. This has been done since by a host of investigators.

Many sources of error must be considered in research on tuberculosis, and only work in which these errors have been definitely excluded can be accepted as conclusive.

My personal estimate of the value of the work of other authors depends on how far these errors have been eliminated. For this reason I will now summarize briefly the requisites for conclusive work on the differentiation between human and bovine tuberculosis.

The animals used for experimentation must be entirely free from spontaneous tuberculosis. Since the earliest stages of tuberculous infection cannot be recognized with certainty, the source of error arising therefrom is only to be overcome by experimenting on long series of animals. This is especially true of investigations on cattle, as in them tuberculin proves the presence of tuberculosis not immediately after infection, but only after the lapse of a certain time. Experiments conducted on too small a number of animals carry no weight whatever. Single exceptions in extensive series of experiments depend, as a rule, on experimental error. They should be valued accordingly or the whole series repeated.

During the entire period of investigation the animals, that is, cattle, rabbits, and guinea-pigs, must be protected rigidly against tuberculous infection. This applies especially to bovine tuberculosis, as the animals are particularly susceptible to this form of the disease, and every experimental error vitiates the results in favor of bovine tuberculosis. Special care must be observed in the separation of animals which have been inoculated with bovine tuberculosis obtained from men under the belief that one is dealing with the human form of the disease. Such animals must never be allowed to come in contact with those inoculated with true human tuberculosis.

Inoculation of animals should be made subcutaneously with weighed quantities of a culture of the tubercle bacillus. Experience has shown that the best results for infection are obtained with doses of 10 mg. Tissue substance must not be used directly, as it contains the tubercle bacilli in irregular distribution. The results obtained thereby are consequently not comparable. It is not practicable to use the tubercle bacilli in too large doses or to make intravenous or intra-abdominal injections, as by such applications non-virulent or even dead tubercle bacilli may produce lesions resembling tuberculosis and thus simulate positive results.

In the preparation of the cultures it is necessary that even while obtain-

ing crude material all precautions must be followed which serve to prevent a contaminating infection either during the inoculation or in the making of the cultures. If it is impossible to make the culture of the bacilli immediately from tuberculous organs,—and this is usually the case,—the material must first be inoculated into guinea-pigs. This is permissible, since it has been proved that a single passage through the body of the guinea-pig does not markedly alter the characteristics of the tubercle bacillus. For infection experiments the culture obtained from the organs of the inoculated guinea-pigs must not be too old, and should be used, if possible, in the first or second generation.

For standardization of virulence rabbits may be used, as a rule, in place of cattle. In all doubtful cases, however, the test must be made on a corresponding number of cattle. In determination of the virulence of the culture of tubercle bacilli it is imperative to distinguish between progressive and regressive processes. For this reason experiments must be continued over a long enough time to enable one to make the differentiation with reasonable certainty. If the animals are killed too early, it is usually impossible to make certain whether the tuberculous processes found are of a progressive nature or not.

It is well to appreciate that mixed infection by human and bovine tuberculosis may occur. In such cases, if proper precaution is not taken in animal experiments, bovine tuberculosis will always gain supremacy and lead to error.

With regard to experiments in feeding phthisical sputum, the following points must be observed:

If under all conditions the so-called sputum contained only tubercle bacilli of the patient in question, the conduct of these experiments would be relatively simple. But every one who has examined sputum under the microscope knows that it is mixed nearly always with particles of food. These, of course, may contain milk and butter which themselves may harbor tubercle bacilli derived from cattle. I consider the experimental error caused thereby of such significance that only those experiments on the occurrence of the bacillus of bovine tuberculosis in sputum can be regarded as conclusive from which this error has been absolutely excluded. In order not to be misunderstood on this point, which is to me of paramount importance, may I be allowed to give the following illustration?

The British Commission which is engaged in the investigation of the relation between human and bovine tuberculosis, has conducted experiments on the feeding of phthisical sputum to cattle. Three calves were fed over a period of one hundred and twenty days, during which time each received a total of 30 liters of sputum. A fourth calf received 21 liters in ninety-one days. After slaughter there were found in these animals isolated calcified

nodules, but no traces of the progressive lesions so characteristic of bovine tuberculosis.

On the other hand, a cow was fed with sputum for two hundred and nine days. When the animal was killed at the end of this time, a progressive tuberculous process was found in the mesenteric and portal glands. Here there appeared to be a positive result of the feeding experiment. However, in simultaneous experiments, in one of which a cow was fed the same sputum for three hundred days, and in the other two pigs, negative results were obtained. Adding to these the four negative experiments on calves, and considering other similar experiments previously performed,—for example, those by myself and by Möller in Belzig,—I cannot but believe that the above result is merely an exceptional case in a large series. The British Commission counts this among its positive results. In my own opinion this is not justified. It seems to me highly probable that in this case an experimental error has slipped in, and that the cow was infected by tubercle bacilli contained in milk or butter which had been mixed accidentally with the sputum.

If such feeding experiments are to be conclusive, it is absolutely essential that sputum collected from various patients must not be used, as has been done probably in all former experiments. The sputum of only one definite consumptive should be fed to one definite animal. Obviously, care should be taken that the patient in question receives during the experiment neither milk nor butter. Furthermore, in order to exclude all error, and to prove that one is dealing with the continuous production of tubercle bacilli by the patient and not with an accidental contamination of his sputum, the experiment must be so arranged that it can be repeated from time to time with the sputum of the same patient.

The experiments carried on at the Kaiserliche Gesundheitsamt in Berlin are the only ones which fulfil in every way the foregoing experimental requirements. Those of the British Commission fail in several respects, and all other work which has come to my notice answers these requirements so poorly that I can grant them no weight, at least as regards the occurrence of bovine tuberculosis in man.

Before taking up the results which have been reached by investigations hitherto, I should like to call attention to the following points:

Many of my opponents have made strenuous efforts to prove that the tubercle bacilli in man and those in cattle cannot be of different species, and they imagine that they can thus refute my contentions. This, however, is a perfectly useless endeavor. I have never held that we are dealing with two distinct species, but have only stated that they differ from each other in certain characteristics, characteristics which are of the greatest importance in combating tuberculosis. Whether these differences justify us in speaking of special varieties or even species is, from my point of view, quite

irrelevant. I am concerned, as I have previously stated, only with the practical significance of the differences between human and bovine tuberculosis.

A very convenient expedient in this dilemma has been suggested by Kossel. He does not use the terms "species" or "variety," but speaks of different "types." As this appears quite harmless, I shall adopt it myself, and use the terms "human type" and "bovine type."

Others of my opponents have attempted to refute me by showing that the bacillus of the human type may be transformed into the tubercle bacillus of the bovine type, and vice versâ, by passages through animals or by cultivation under artificial conditions. In this connection I can merely repeat that I am interested only in the practical significance of the difference between the two types of tubercle bacilli. For our purposes, that is, for combating tuberculosis, it is absolutely without significance what changes tubercle bacilli will undergo after being passed through a series of animals or during cultivation under some artificial conditions. Those men who consume milk and butter do not hold back and make cultural or animal experiments: they eat them in the fresh, unchanged condition. In my opinion, therefore, we are concerned here with the properties of the fresh and unchanged tubercle bacillus only. I do not deny that cultural transformations may be made with these as well as with other bacteria, but this is a question of purely theoretical value. I shall therefore lay it aside.

We may now take up the results of recent investigations. I believe that what has come to my knowledge so far may be summarized briefly as follows:

All competent investigators agree that the tubercle bacilli of human origin differ from the tubercle bacilli of cattle, and that, consequently, we must differentiate between a typus humanus and a typus bovinus. The British Commission also admits the existence of these differences, but as some of their cultures showed definite changes in their characteristics after passage through animals and various cultivations, they have differentiated a third group, which they call "unstable." As I have repeatedly emphasized, it is not of the slightest importance to us whether, after animal inoculation or breeding experiments, the tubercle bacillus is stable or unstable. What concerns us is behavior in the fresh condition. I am therefore unable to accept this third group of the British Commission, and I am satisfied with their admission that the fresh tubercle bacilli of the human type differ distinctly from those of the bovine type.

The tubercle bacilli of the human type are characterized by the fact that they grow rapidly and abundantly in a thick layer on glycerin serum. They are virulent to guinea-pigs, slightly virulent to rabbits, and almost non-virulent to cattle.

The tubercle bacilli of the bovine type grow very slowly and in a thin layer on glycerin serum; they are of equally high virulence to guinea-pigs,

rabbits, and cattle. To my knowledge, the bacilli of the human type have never been demonstrated in cattle.

The bacilli of the bovine type, on the other hand, can occur in man. They have been found in the cervical lymph-glands and in the intestinal tract. With few exceptions, however, these bacilli are but slightly virulent for man and remain localized. The few known cases in which the bovine tuberculosis is said to have produced a general and fatally progressive tuberculosis in man appear to me not to be above suspicion.

No special proof is required if I say that these results constitute the confirmation of the statements which I made at the London Congress.

In closing, I have still one point to discuss which seems to me of high importance.

Of all human beings who succumb to tuberculosis, eleven-twelfths die of consumption or pulmonary tuberculosis, and only one-twelfth of other forms of the disease. One would have expected, therefore, that those investigators who are interested in establishing the relations between human and bovine tuberculosis would have searched for bacilli of the bovine type preferably in cases of pulmonary tuberculosis. This, however, has not been the case. Evidently animated by the desire to bring together as many cases as possible of bovine tuberculosis in man, they have investigated particularly cases of gland and intestinal tuberculosis, and have neglected the much more important pulmonary tuberculosis. In spite of the bias under which the researches hitherto have suffered, there yet remains at our disposal a sufficient number of investigations of pulmonary tuberculosis to warrant a provisional expression of opinion.

The gist of it is—and I beg you to take note of it—that up to date in no case of pulmonary tuberculosis has the tubercle bacillus of the bovine type been definitely demonstrated. If, on further investigation, it should be established that pulmonary tuberculosis is produced by the tubercle bacillus of the human type exclusively, then the question will be decided in favor of the view which I have upheld, and we must direct our regulations for combating tuberculosis by all means primarily against the tubercle bacilli of the human type.

On account of the great importance of this question I intend to undertake as soon as feasible experiments along this line on a broad scale. At the same time I wish to make my plea to other tuberculosis workers, in order that as many cases as possible may be examined, to join with me vigorously in this task. But I wish to lay stress on the fact that the conditions laid down by me for the carrying out of these investigations must be followed. I consider it quite possible that in this manner the essential facts for deciding this important question may be collected in about two years and be presented to the next International Congress.

THE RELATION BETWEEN HUMAN AND ANIMAL TUBERCULOSIS,

WITH SPECIAL REFERENCE TO THE QUESTION OF THE TRANSFORMATION OF HUMAN AND OTHER TYPES OF THE TUBERCLE BACILLUS.

By Theobald Smith, M.D.,

George Fabyan Professor of Comparative Pathology in Harvard University Medical School.

The tendency of practical medicine to move faster in theorizing than the demonstrated facts and accumulated data of observation and experiment warrant is again manifest in the hypotheses which have recently been advocated concerning the relation existing between human and animal tuberculosis, and the portals of entry of the tubercle bacillus. Any clear insight into these problems is greatly complicated by variations in the virulence of the bacilli, on the one hand, and variations in the degree of natural and acquired immunity in the invaded host, on the other. As a result, opinions and views concerning fundamental questions differ widely. In the following pages I shall endeavor to confine myself to the experimental and other evidence bearing on the hypothesis recently put forth: that bovine tubercle bacilli may assume the human type in the human subject, and that human bacilli may become bovine in type in cattle.

A survey of the investigations thus far published reveals a practical unanimity among investigators that there exists a sharp, easily recognized difference between the type of bacilli isolated from sputum or from the lung tissue in pulmonary tuberculosis of man, and the type isolated from tuberculous cattle. The designation "human" and "bovine," which I applied tentatively to these types in 1898, has been generally accepted.[1]

The differences between these types pertain to morphological, cultural, and pathogenic characters. On serum the human type is longer and more slender than the bovine type, and slightly curved. It grows readily from the start, often profusely, and after the first generation multiplies freely on glycerin-agar and glycerin bouillon, forming on the latter a thick, nodular, or puckered membrane. The colonies on serum are in the characteristic S-shaped bundles first described by Koch. The bacilli in the bovine colonies are grouped irregularly, without any distinct conglutination, into bundles. After the bovine bacillus has vegetated for several generations on egg or

serum it will begin to grow feebly on glycerin-agar and bouillon, where it forms a very delicate membrane, suggesting tissue-paper with occasional thickenings in it.

After a fairly vigorous growth has established itself on glycerin bouillon, the bovine type presents the peculiarity of converting a bouillon containing 5 per cent. glycerin, and of a certain degree of acidity to phenolphthalein, into an alkaline medium. The human type does not do this. At the end of one to two months the bovine type is alkaline, the human type acid. The acidity of some types reaches 4 per cent. of a normal solution; that of other types, but 1.5 to 2 per cent.

It will be impossible for me in this paper to go into any details concerning this test, but I hope to present the method and its pitfalls in more detail in a future paper, and incidentally meet some of the criticisms leveled against it. All that it will be necessary for me to state here is that after a trial of seven years I find the acid or alkali production of different strains, under cultivation from one to fourteen years, constant. In all experiments in which the identity of cultures is at stake, that is, in experiments designed to test the capacity for transformation of different races by passages through animals, the reaction curve of the culture should be carefully studied beforehand as an important aid in recognizing it.

The third striking distinction between the human and the bovine type is revealed in their action upon rabbits and cattle. The bovine bacillus is highly pathogenic for these species; the human type is not. Though the bovine bacillus slowly degenerates in virulence with prolonged cultivation, yet its virulence for these species is remarkably tenacious. In 1906 a bovine culture isolated by me twelve years before, and kept growing on glycerin-agar, was still capable of killing a calf in a dose of 10 mgm. injected into a vein. Doses of 2.5 and 5 mgm. failed to do this.[2] It is well known that many strains of the human type have been used without the slightest harm upon cattle for purposes of immunization.

With these two types before me, I urged, now ten years ago, that the relationship between animal and human tuberculosis be subjected to renewed, thorough, scientific investigation. During these ten years an enormous amount of labor has been expended on this problem, and great progress has been made. The bovine type of the tubercle bacillus has been detected in man, but almost exclusively in infections pointing to the digestive tract as a portal of entry. It has been found in the tonsils, the cervical lymph-nodes, the mesenteric lymph-nodes, and in other organs in the generalized disease starting from these primary foci. It is probable that De Jong[3] and Arloing[4] isolated it from sputum. But the fact remains that bovine infections are essentially alimentary in origin and localization, and largely restricted to childhood. At the same time, the human type has been found

in the same lymph-node infections, and apparently any diagnosis as to which organism might be encountered by an examination of the lesions, during life or post mortem, is at present impossible. In three cases Kossel, Weber, and Heuss[5] found both types in the same body. In one of these the two types occurred in the same culture, and were finally separated with great difficulty. A rough and liberal estimate would make from one-fourth to half the cases of tuberculosis starting in the cervical and the mesenteric lymph-nodes bovine in origin. This achievement, to which so many have contributed, has placed our knowledge concerning the infection of man from cattle on a firm basis.

Recent years, however, have brought forth two doctrines which have tended to unsettle this dearly bought and clearly cut bacteriological victory. These doctrines are: (1) the transformation of the three types of tubercle bacilli one into the other; and (2) the more or less exclusively alimentary source of tuberculosis. This is really a necessary corollary of the doctrine of the transformability of types to account for the almost exclusive presence of the human type in pulmonary tuberculosis. This possibility has presented itself to all investigators. It was first suggested by me as worthy of careful investigation in 1898.[1]

The data upon which the doctrine of transformability is based are: (1) The reciprocal immunizing properties of bovine and human bacilli; (2) the changes undergone by bovine tubercle bacilli during cultivation; (3) the occurrence of so-called intermediate type; and (4) the results of some experiments in which certain strains passed through a series of animals have undergone modification.

The reciprocal immunizing properties of bovine and human bacilli are a strong argument for their close relationship, and not necessarily one establishing their identity. That these two types stand very near to each other cannot but force itself upon the attention of all who study them at close range. We know that they have a common toxic basis in tuberculin, and probably come from a common ancestor, but the question whether the two types have become so specialized by adaptation to different hosts as to have lost the capacity for being transformed, one into the other, is still unanswered. The real mechanism by which immunity is induced, and the components or products of the bacilli chiefly responsible for it, must first be known before we can use this phenomenon as evidence of identity.

The changes undergone by bovine tubercle bacilli after one or more years of cultivation are a slow reduction of virulence and an increased saprophytism. As a rule, cultures on glycerin-agar and bouillon cannot be distinguished by their appearance from the human type after several years of cultivation. The richness of growth in a given time is practically the same. These changes, visible to the naked eye, are not accompanied by any other marked alterations, however. The reaction curve in bouillon remains prac-

tically the same, and the rate of the loss in virulence is no greater than with human cultures. The gap between them, therefore, remains the same. Temporary modifications may also be observed. Some years ago I noticed a sudden decided change in the morphology of the bacilli and in the gross appearance of the cultures of three bovine strains in coagulated serum which accidentally contained a slowly liquefying bacillus.[6] After the cultures had been purified by a single passage through rabbits, the original characters at once returned in all three cultures. Recently, in isolating a bovine strain on Dorset's egg medium, I found one tube containing large, smooth colonies of tubercle bacilli such as I had not seen before, while the rest contained the usual very minute colonies. A microscopical examination revealed a contaminating coccus in this one tube. It has happened several times that the first transfers of human cultures, strikingly resembled the avian type of growth. In subsequent cultures this completely disappeared. On the other hand, an avian culture, originally from a pigeon, and now ten years under cultivation, can still be picked out from among twenty to thirty other stocks of mammalian cultures. These random illustrations show that bovine bacilli may undergo temporary modifications which simulate more trenchant differences. If carefully sought for, explanations are usually forthcoming. The causes being removed, the appearances characteristic of the type return. These changes I attribute to alterations in the outer membrane of the bacilli, whereby they become more sticky, and perhaps also more permeable to nutritive substances. In the case of impure cultures, the enzymes of the adventitious bacteria may accomplish this. In fact, the entire scale of degenerations witnessed during prolonged cultivation of the bovine bacillus from first to last is at present most easily explained by some kind of degeneration of the outer membrane or capsule. These changes do not necessarily have anything to do with a change in the type of the organism, although they may simulate or run parallel to the usual characters of other types.

The occurrence of so-called intermediate types is reported by many observers. Cultures of this class cannot be ranged, we are told, under the typical bovine and human types. The aberrant features pertain to either cultural or pathogenic manifestations. From the descriptions it is not always clear whether such aberrant cultures were followed long enough to determine the temporary or permanent character of the differences noted.

It is, of course, no unexpected thing to find in the same species of bacteria cultures slightly different from each other. This has occurred whenever any well-defined species of bacteria has been subjected to prolonged scrutiny. The importance or value of such differences must be carefully determined. A culture isolated by me in 1902 from a child, and pronounced bovine from its effect on rabbits and cattle, grew with great difficulty. After six and one-half years of artificial cultivation it is still easily distin-

guished from four bovine strains growing with it, by its backward growth. Even under the microscope the bacilli to-day fail to show those changes which are noticed in bovine cultures of similar age. All that we can say of this stock is that it has strongly resisted deterioration, and in this respect deserves to be regarded as a variety.

The other character on which these intermediate types are founded is higher or lesser virulence, according as we compare them with the bovine or the human type. This character taken by itself should not be regarded too seriously. That virulence should slightly fluctuate about a standard is as natural as that leaves of the same tree, or red corpuscles from the same individual, or other biological entities, can be grouped around a mean. In all cases differences should be reëxamined after a certain period of cultivation, and not at once the inference drawn that they are permanent. There are many conceivable ways in which virulence might be slightly raised or slightly lowered. Bovine bacilli vegetating for a long time in a tuberculous udder, or in tubercular bronchopneumonia, could hardly be expected to be as virulent as those discharged from a newly opened focus. Similarly, long-standing pulmonary tuberculosis with cavity formation in man might furnish bacilli of lower virulence than a fresh case, following in close succession several other cases, each derived from the preceding. We have no good reason to deny the existence of bacilli of the human type which, owing to special conditions, might, after intravenous inoculation, prove fatal to calves. This position has been assumed by Baumgarten and his pupils, and one of the latter (Tatewossianz[7]) goes so far as to maintain that there is no satisfactory proof that the bacilli from man which have been referred to the bovine type are actually of bovine origin. Some of the so-called intermediate types are said to grow more vigorously at the start than the true bovine bacillus. This may be accounted for without destroying the identity of types. The rare occurrence of strains of very low virulence which follow the reaction curve of the bovine type in glycerin bouillon is perhaps more significant, especially if this character persists after prolonged cultivation.

Some of the aberrant strains encountered in man and domestic animals may represent a degenerated bovine type; others may belong to the human type, augmented temporarily in virulence. In weighing or estimating the value of these differential characters we must distinguish between a merely transitory, temporary change and a more permanent difference; and, above all, we must keep in mind the distinction between passive degeneration in, and active adaptation to, the changed environment found in a foreign host. This passive degeneration of the bovine type which is observed regularly in artificial cultures after years, goes on, I am inclined to believe, in all hosts other than the bovine race, for none of the bovine types which I have isolated from man, horse, swine, and cats seemed to have just the maximum

virulence of bovine bacilli isolated from cattle directly. However, my observations have been too limited to be used for generalizations. Degeneration in virulence, associated perhaps with more active growth, must be regarded as a natural phenomenon affecting bacteria as well as other forms of life when taken out of their usual environment. That it may eventually lead to change of type is unproved, but not to be denied.

To what extent foreign animal hosts may modify bovine bacilli is a problem whose importance has not escaped others. The Royal Commission has promised us researches in that direction, and the investigations of Lydia Rabinowitsch[8] on birds are along this line. Indeed, much work has been done already. Perhaps the most suggestive are the results from swine. These animals are becoming more and more infected with tuberculosis, and, so far as I have been able to learn, all the cultures which have been isolated are bovine in type. The three I have studied are typically so. Although the pig may be artificially infected by feeding human bacilli, yet we have still to find a spontaneous case due to the human type. In this species, evidently no appreciable modification takes place. Among other species both bovine and human bacilli have been encountered.

In general, it may be stated that cultures from foreign hosts have not been studied with that care and circumspection demanded by the problem to be solved. The spontaneous infection of species other than man and cattle is a great experiment of nature, and this experiment should be utilized as thoroughly as possible in the future in determining what changes, if any, are caused by foreign hosts which do not, as a rule, transmit the disease to others of the same species.

The most important data for estimating the possibility of a transformation of types are furnished by the passage experiments with different species of animals. Such experiments have been reported by Nocard, Ravenel, von Behring, the writer, de Jong, Dammann and Müssemeier, the English Tuberculosis Commission, Mohler and Washburn, the German Imperial Health Office, Shattock *et al.*, and O. Bang.

Those who would to-day undertake experiments of this kind must expect a very rigid scrutiny of details surrounding such experiments. Unfortunately, many details are left to the imagination of the reviewer, for they are too numerous to be recorded.

Without going into minutiæ concerning the various passage experiments, it may be stated that they can be roughly separated into two groups: (1) Those in which cultures only were employed, and the bacilli recovered each time between two successive passages; and (2) those in which either tuberculous tissues only, or tissues alternating irregularly with cultures, were used to continue the passages.

Of the first group, the following may be mentioned: von Behring, Roemer,

and Ruppel[9] succeeded once in increasing the virulence of human bacilli by passing them through a goat. Other attempts with the same stock failed. The writer passed bovine and human cultures through a series of rabbits without any appreciable change.[10] A vigorously growing old bovine culture was isolated after six months' sojourn in a heifer without having lost any of its saprophytic vigor.[2] Kossel, Weber, and Heuss[11] passed one human culture through four goats, the same through three cattle, a second strain through five goats, and a third through three cattle without changing the characters of the type. Stanley Griffith[12] and F. Griffith, for the Royal Commission, passed bovine strains through series of chimpanzees, baboons, monkeys, dogs, guinea-pigs, and through a pig. Their conclusion is that "the bovine bacillus is very retentive of its special cultural characters and high virulence." In general, the results of these passages have been negative so far as any recognizable modification of type is concerned. When we compare these with the other group of experiments, those in which ground-up tubercular tissues were injected, we find a different outcome.

De Jong[13] inoculated a goat with a human culture. After the death of the goat, which occurred three years and one hundred and forty-five days after inoculation, he passed tissues from this case and cultures through a guinea-pig, goat, calf, guinea-pig, and calf. Another series, starting with the goat mentioned, consisted of a guinea-pig and two calves. In both series the last calf died of generalized tuberculosis within a short time.

Ravenel[14] passed a human culture through five calves, using suspensions of tissues after the first. A decided jump in virulence occurred after the first passage. Dammann and Müssemeier[15] passed a slightly virulent culture through goats with the aid of tissue suspensions, and obtained a bovine type after the fourth and fifth passages. Shattock *et al.*[16] passed sputum through pigeons without producing any noticeable changes. Passage experiments with tubercular tissues are also reported by A. Eastwood for the Royal Commission.[12] Three cultures, at first slightly virulent, became highly so; all were classed with the bovine type. Mohler and Washburn[17] increased the virulence of two human cultures by passage through cattle. The tissues used for subcutaneous injection were obtained in one case from a rabbit and a calf in succession; in the other from a rabbit, a dog, and a cat. Both these strains are reported by them as following the reaction curve of the human type in glycerin bouillon. Lastly, O. Bang,[18] by the use of cultures and tubercular tissues, claims to have converted bovine into avian bacilli by passages through fowls and rabbits.

Most of these experiments have been reviewed and criticized by others, and their vulnerable features pointed out. To analyze them in detail would be impossible, and I venture simply to state my own inferences briefly. Four interpretations may be placed upon them: (1) They may be due to the

accidental introduction of new strains during the experiment, or the use of mixed strains from the start. (2) They may be accounted for by the rehabilitation of an originally bovine culture, modified or degraded in one way or another by passages through other hosts, or saprophytic vegetation in cavities, etc. (3) They may be due to the augmentation of virulence by the peculiar methods used, without change of type. (4) They may be due to an actual conversion of human into bovine types.

The third interpretation is the one which I think meets the situation best. While some of the experiments are faulty, I think that it is improbable that in all these cases there should have been introduced adventitious strains. The increase in virulence obtained by the injection of tissue fragments is probably due to the protection afforded by the tissues to the injected bacteria. The repeated transfer of such material tends toward a selection of bacilli which become more virulent in consequence. There is no reason to deny the possibility of an increase in virulence of bacilli from one type, which are made to flourish forcibly and under unnatural conditions in animals in which such type does not occur. But the increased virulence does not mean change of type. Before we can safely accept the transformation of the bovine into the human type, or the reverse, it must be shown that the bacilli correspond in every particular to the type into which they are supposed to be converted, and they must maintain the characters of the type under prolonged cultivation. They must also produce the type of disease anatomically and histologically obtainable with the natural virus of the same age. To simply register augmentation or diminution in virulence does not prove that the type has been altered. It must also be shown that the virus obtained by passages is capable of infecting in the natural way, by feeding or inhalation, or both, for there is at present no evidence at hand that these subcutaneously or intravenously produced artificial strains can successfully compete with the natural strains, *i. e.*, enter through the usual portals in small numbers, and maintain a continued existence by producing disease.

The most recent work of O. Bang[18] has not yet been repeated by others; hence I hesitate to consider it seriously at present. Bang seems to have converted a number of strains of bovine into avian types. The ease with which this has been done should make reproduction of his actual experiments relatively simple. All of his results, however, could be explained as due to the accidental presence of the avian bacillus. The first experiment might indeed be interpreted as a case of mixed bovine and avian culture separated by means of a fowl, a rabbit, and a guinea-pig. Before accepting his conclusions, it will be necessary to repeat his experiments in a territory relatively free from the avian disease, and with all precautions against contact with pigeons, rats, mice, etc., for his work indicates that avian tuberculosis is prevalent in Denmark, and that he actually isolated an avian culture from

cattle. It will also be necessary to know how long the avian characters persist in subsequent cultures, and whether they produce the typical histological lesions of the avian disease in susceptible animals. Lastly, a strain so readily changed should be equally ready to return to its former state when passed through cattle. But, granting that there has been no admixture with avian strains occurring either in his cultures or in the fowls used by him, I believe that his results are capable of explanation on the following lines. Any modification of the outer envelop of the bovine bacillus by enzymes of the pigeon would influence both its appearance in cultures and its virulence, for it would be more easily destroyed in certain species. If, however, such modified characters persist indefinitely, either in animals or in cultures, and render the cultures indistinguishable from the avian type, we must consider the transformation a settled fact.

The time has not yet come for us to state positively that one type can or cannot be transformed into the other. The very nature of the methods employed leaves a big gate for errors to sneak in, and the proof, if it ultimately comes, will be more in the nature of a majority vote than a demonstration. In the mean time we may safely take the ground that any regular or wholesale conversion of bovine into human bacilli in the human body is out of the question, as contradicted by most of the experimental evidence thus far presented, and by certain observations made on the occurrence of the spontaneous disease. We know that human tuberculosis can exist without the aid of bovine tuberculosis, and an important aid in the final solution of this question will be the study of human tuberculosis in such regions where the bovine disease does not prevail, and where the dairy products are not shipped in from countries afflicted with the disease.

Among the first to call attention to the prevalence of the human disease in the absence of the bovine disease was Kitasato,[19] who in 1904 pointed out that human tuberculosis exists in Japan in all types, although the bovine disease does not enter as a factor. In a village in northern Sweden, Regner[20] described recently an unusual number of cases of tuberculosis, not only pulmonary, but glandular in type. Bovine tuberculosis could not be found by official veterinarians, and tuberculin gave no reaction in any of the local herds. Recently Heymann[21] has called attention to a number of places where cows' milk is either a very insignificant factor or none at all in the feeding of infants and children, and where human tuberculosis is very prevalent. I am also informed by Dr. A. B. Withington that human tuberculosis is very prevalent on the Labrador coast, but that milk and dairy products are very scarce. Perhaps more foci of this nature will be discovered in the future. A thorough study of the tubercle bacilli found in such places would throw fully as much light upon the questions before us as any number of passage experiments performed amid the dangers of outside infection.

On the other hand, there are good reasons for continuing investigations to determine whether an occasional transformation does not occur. For, basing our inferences upon the work already done, we must admit that such transformation has not yet been demonstrated, but that its possibility cannot be denied. The rare combination of conditions necessary to effect a new creation of this kind would probably make it of little practical importance. The experiments already made, which give some hope in this direction, indicate that only certain viruses, passing through certain species of animals, and in a certain definite order, might accomplish the feat. Whether any one will ever discover this hypothetical combination, and unlock the mystery of bacterial races for at least one species, must be left for the future to answer. For the practical sanitarian, I venture to predict it will continue to remain then, as now, an academic proposition.

In conclusion, I wish to suggest the following lines of research, to be carried on with the most reliable and discriminating methods devised up to the present:

1. A continued study of cases of pulmonary tuberculosis with the view of ascertaining if the bovine is exclusively responsible for any cases in which a regular discharge of tubercle bacilli takes place.

2. A further study of the transformability of tubercle bacilli by passage of tissues containing bacilli and guarded from all possible sources of error, together with a most careful examination of the nature and permanency of the changes induced.

3. A study of the varieties of tubercle bacilli among populations where dairy products coming from tuberculous cattle can be excluded as a contributory cause.

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THE RELATIONS OF HUMAN AND BOVINE TUBERCULOSIS.

By Professor G. Sims Woodhead,
Cambridge, Eng.

I am very glad indeed to have the opportunity of taking part in what must be one of the most important, as it is certainly one of the most interesting, questions set down for discussion at this Congress. In any remarks I may make I should like it to be understood that, widely as we may differ from Geheimrath Koch on certain important points, the members of the British Royal Commission can in no sense of the term be spoken of as his opponents except in a purely technical sense—the sense in which I think Professor Koch must have used it. Professor Koch has placed before us a problem, and in attempting to obtain a satisfactory elucidation of this problem we are all working to one end, and in doing that are, I think, paying the greatest compliment to Professor Koch that it is possible for any body of scientific men to pay to a colleague. Speaking personally (I believe I may speak for the whole of my colleagues on this point, and I shall commit them on no others), I have the greatest admiration for the work that Professor Koch has done. I believe, indeed, that no single investigator other than Professor Koch could have enticed investigators in Great Britain to reopen this question. Withal, it must be evident that they had doubts as to the accuracy of Professor Koch's conclusions, and that in forming their own conclusions they can accept no "authority," but must rely entirely on their own experiments and observations.

As to the conditions ("requisites for conclusive work") laid down by Professor Koch,—might I say, almost unnecessarily at this stage of the work, and with the proceedings of the Royal Commission on Tuberculosis, of which I have the honor to be a member, before us,—the greatest care has been exercised to exclude possible sources of error. In this part of our work we have received every assistance from the national treasury, and our British Parliament has sanctioned the expenditure of very large sums on animals, accommodation, assistance, and the like. Through the generosity of Lord Blyth we have been able to carry on the two branches of our work (experiments with tubercle bacilli of the bovine and of the human type) at farms situated at a considerable distance (considerably over a mile) apart. At each of these is a laboratory at which the special work may be carried out, while all mate-

rial, cultures, etc., from these farms which have to be compared are examined and worked up at a laboratory situated midway between the two farms. The attendants, etc., of the one farm are never allowed to go on to the other, and direct communication between the farms is never allowed; in this way all danger of interinfection has been reduced to a minimum. In fact, it may be said to be non-existent.

As to the point raised by Professor Koch, that "the animals used for experimentation must be entirely free from spontaneous tuberculosis," we are in a specially favored and favorable position. We are fortunate in having near our shores an island—Jersey—in which spontaneous tuberculosis has never yet broken out in the herds. We have therefore been able to obtain a very large and constant supply of healthy bovines on which to carry out what I think those who have read our report will consider an extensive series of experiments—a supply such as is obtainable in no other place in the world, certainly in no other place where such investigations had been carried on. We, of course, greatly diminished the risks of accidental contamination by separating the farms and laboratories, while we have been exceedingly fortunate in obtaining the services of most competent, well-trained, and enthusiastic assistants, in whose care and ability we have seen ample reason to place the fullest confidence. Our methods and results are set forth in the appendices to our reports in the greatest detail, in order that those who may feel inclined to question our conclusions may see the data on which such conclusions are based. In this connection may I ask those who read our reports, and who have any doubt as to any details, to go to these appendices direct, and not to accept the generalizations of any one until they can form an opinion of our work?

I have already stated that in carrying on our work we have lacked neither facilities nor financial assistance, and I must ask you to accept this as evidence that neither the Commission nor the successive governments by which we have been appointed, continued, and supported, look upon this as an academic question, but rather as an intensely practical one, on which very grave issues depend—a question set before us by the greatest authority of our time. We felt, therefore, that we should leave no stone unturned to test the accuracy of statements and evidence offered by so great an authority—indeed, by two such authorities; but we were not prepared to accept anything that we could not confirm by patient and accurate investigation, especially in view of certain results obtained at a comparatively early stage of our investigations. I am glad that Professor Koch has selected the one feeding case for criticism, as it affords me an opportunity to point out that this series of experiments was one of the first we carried out. I may say that the sputa were taken with special precautions from patients in a large hospital where the milk, at any rate, is sterilized. Throughout our experiments we took

special pains to eliminate the dangers to which Professor Koch has just referred. Allowing for a moment, however, for the sake of argument, that there were flaws in this preliminary case, I should like to draw attention to the other cases bearing on the same point, to which Professor Koch has made no reference, in which, I believe, no similar weak point open to criticism will be found.

It is surely a question of more than merely academic interest that some 30 per cent. of the cases reported (not by the British Royal Commission only, but including the figures given of the German Imperial Commission) are of alimentary origin, and Dr. Cobbett, who has done such excellent work for the British Commission, working on these figures, calculates that about 7 per cent. of the cases with which we have to deal, result in all probability, from infection with tubercle bacilli of bovine origin; and surely 7 per cent., allowing a little latitude on either side of this figure for errors in statistics, observations, and calculations, can scarcely be looked upon as a negligible quantity. I may say that, bearing in mind what we now know of the curability of tuberculosis under favorable conditions, I am of opinion that this figure represents an under statement rather than an overstatement of the cases which result from infection with the bacillus tuberculosis of the bovine type.

Professor Koch states, in view of the fact that "of the human beings who succumb to tuberculosis, eleven-twelfths die of consumption, of pulmonary tuberculosis, and only one-twelfth of other forms of disease; one would have expected, therefore, that those investigators who are interested in establishing the relations between human and bovine tuberculosis would have searched for bacilli of the bovine type preferably in cases of pulmonary tuberculosis. Evidently animated by the desire to bring together as many cases as possible of bovine tuberculosis in man, they have investigated particularly cases of gland and intestinal tuberculosis, and have neglected the much more important pulmonary tuberculosis." May I point out that, so far as we were concerned, this course was adopted out of compliment to Professor Koch, and for the purpose of supplying him with material which he had been unable to find in any large proportion of cases in Germany, as we knew from previous experience that such cases might be found in considerable numbers in this country. Moreover, it was important to settle the question, Are the bacilli found in these alimentary cases virulent for bovines and rabbits? These two questions settled, and both were settled in the affirmative, it was unnecessary to continue making any special selection of such cases, for, indeed, we found that we obtained a sufficient number by taking cases as they presented themselves. As I have already stated elsewhere, we have given all our figures, and the figures relating to these are included with the others, not for the purpose of bringing "together as

many cases as possible of bovine tuberculosis in man," but of meeting prospective criticism and of giving the data on which our conclusions are based.

With regard to the question of the third group formed by the British Commission, and the question of modification of tubercle bacilli, you will readily understand that I am not in a position to say more than has already appeared in the reports of that Commission. It will be evident, however, to any one who will read the report carefully, that this is a group formed simply for the sake of convenience, because the members of which it is composed did not come under the heading of either group I or group II, and to me it does not seem to be a matter of any great importance that it should be accepted as a group. Though the group may be easily enough disposed of, the individual members of the group cannot be treated so lightly, and I feel convinced that if Geheimrath Koch will examine these members, he will not think it necessary to brush them aside as unworthy of comment or observation, but will consider them more in detail than he is at present inclined to do. They are simply spoken of as unstable from the fact that instability is a somewhat prominent character, but it must be pointed out that at the time they are separated from the animal, individual members of the group offer different degrees of virulence and different forms of growth from those met with in the two extreme types contained in groups I and II. It is not possible at present to say that these have no practical importance, and it is surely going beyond the bounds of scientific prudence to state that a bacillus introduced as a moderately virulent organism may not give rise to a more virulent progeny in the same individual, at first, perhaps, setting up a modified, but at a later stage a more active, process. As Professor Koch points out, we are not dealing with a laboratory experiment in which all the conditions are controlled, but with a case of infection, continuing how long we can scarcely say, passing through what stages we cannot determine, the results only becoming apparent when the infection has become effective in the production of a marked or diagnosable disease. I should like to point out that we have a warning illustration in what was, and is, taught as to the infectivity of tuberculosis even subsequent to the date of the discovery of the tubercle bacillus. The interval between the infection and the manifestation of the disease is so great that many observers could not bring themselves to believe that cause, as we now know it, and effect were in any way associated. The acceptance of the view of infection was delayed because of the slow growth of the tubercle bacillus and the tardy manifestation of any symptoms, and it was only when brilliant and patient men, of whom Professor Koch was chief, entered upon an investigation of the question that this point was settled. Even to-day, although the infective theory has been generally accepted, there are many who do not believe in it simply because of this long period of incubation. I do not hold a brief for the modification theory. At present I

consider that we have not sufficient information to form any definite opinion, but I think we have sufficient to warn us against throwing it aside as unworthy of consideration. Ought we not to expect, on account of this slow growth of the organism and of its slow development in the body, to find much greater difficulties in tracing any modification, either in morphological characters or in the virulence of the tubercle bacillus, than in the case of the more rapidly growing and more quickly striking disease-producing organisms? If we can find these modifications as regards form, mode of growth, degree of virulence, slight modification of function, among the more rapidly growing organisms,—such as the diphtheria bacillus, the cholera bacillus, the typhoid bacillus, the pneumococcus, and the like,—are we justified in eliminating the possibility of some similar change or changes taking place in the more slowly growing tubercle bacillus? It may be a very difficult matter to trace these changes; in fact, we should expect to find the difficulties of tracing these modifications increased in direct or greater proportion to the diminished rate of growth of this organism. May not the same conditions which regulate the modification of the more rapidly growing bacilli operate in the case of the more slowly growing tubercle bacillus? Not only must the period necessary for these modifications to come into effect be longer, but we may have to seek for fresh conditions in nature, which up to the present we have not been able to copy in our experiments and artificial infections, but which may ultimately come to be at our disposal. I certainly think that we have sufficient evidence before us to warrant us in maintaining that success, even in this direction, is not out of the question. Without going into any other points, and to bring to a conclusion my somewhat rambling remarks, let me say that of one thing I am thoroughly convinced, and that is that until a clear negative is proved, those who take the risk of giving it out that there is no danger to the community, either directly or indirectly, through an increase of tuberculosis among cattle, and that there is no danger of infection from cattle to man, especially to the human infant, incur very great responsibility indeed. As for myself, I am so satisfied with the nature of the evidence that has already been obtained, not only in England, but in Germany, in France, in Denmark, not to speak of important investigations carried on in other countries, that I am unwilling to countenance the relaxation of a single regulation for the control of bovine tuberculosis. Indeed, I will go further, and state my strong conviction that in the interests of hygiene, and with a view to the final stamping out of tuberculosis from the human race, additional and more stringent regulations will undoubtedly have to be drawn up and applied.

Dr. Leonard Pearson, President of Section VII, here took the chair.

SUR LES RAPPORTS DE LA TUBERCULOSE BOVINE ET DE LA TUBERCULOSE HUMAINE.

Par Dr. S. Arloing,
Lyon.

La question qui retient aujourd'hui l'attention du congrès a été soulevée pour la première fois par les observateurs des Etats-Unis, lorsque Theobald Smith, Gaiser, Dinwiddie, Frothingham, ont signalé des différences morphologiques et pathogéniques entre les bacilles de l'homme et ceux du boeuf.

MM. R. Koch et Schütz l'ont solutionnée en 1901, au Congrès de Londres, de manière à provoquer dans le monde des hygiénistes une émouvante surprise.

L'homme, disaient ces éminents expérimentateurs, n'a rien ou presque rien à craindre de la tuberculose du boeuf, parce que les bacilles qui sévissent sur des deux espèces sont absolument différents. Cette opinion était traduite, un peu plus tard, par M. Schütz, au milieu d'une discussion à la Société de Médecine interne de Berlin, par les termes suivants: "L'homme et le boeuf sont deux êtres différents ayant chacun sa tuberculose" dont la signification est non moins nette.

M. le Prof. Robert Koch affirme aujourd'hui qu'il n'a jamais nié la transmissibilité de la tuberculose bovine à l'homme, qu'il s'est borné à signaler la rareté de la transmission.

Assurément la pensée a été mal saisie à Londres, car si elle avait été bien comprise, on n'aurait pas vu éclore la multitude de travaux, dont quelques uns outrement couteux, qui enrichissent nos documents sur la tuberculose. Nous n'avons pas à regretter ces efforts, résultats d'un malentendu, car ils nous premettent d'asseoir nos raisonnements sur des bases scientifiques.

En insistant sur la rareté de la contamination de l'homme par la tuberculose animale, notre éminent collègue ne peut faire état que de deux facteurs:

1. Une différence profonde entre les deux bacilles;
2. Un défaut de réceptivité de l'homme pour le bacille d'origine bovine.

A l'appui d'une différence entre les deux bacilles, on a cité des particularités soi-disant, très nettes de leur pouvoir infectant, de leurs caractères morphologiques et biologiques, des caractères histologiques des lésions qu'ils produisent dans les tissus. J'ai publié aux diverses occasions, le résultat de

mes recherches, sur tous ces points, corroboré depuis par des travaux nombreux et considérables. Il suffice de la rappeler. (a) Au point de vue de l'inoculabilité, il n'y a pas de différence absolue entre le bacille humain at le bacille bovin. Tous deux peuvent infecter toutes les espèces animales par toutes les voies. Si le bacille bovin est d'ordinaire plus virulent que le bacille humain, ce dernier est parfois aussi virulent que le premier, et il existe des bacilles bovins qui ne dépassent pas la virulence moyenne du bacille humain. (b) Sur le terrain de l'anatomie pathologique, on ne relève pas non plus de différence essentielle. Comme je l'ai montré dans mes travaux avec Paviot et Thévenot au début de leur évolution, les lésions sont semblables. Quant aux lésions non folliculaires, atypiques, on les observe après l'inoculation de l'un et de l'autre bacille. (c) Que dirai-je des caractères morphologiques et biologiques des bacilles, de la forme des colonies sur milieu solide ou liquide, de la pigmentation, de la réaction prise par les milieux de culture, sur laquelle Theobald Smith a insisté récemment, de la forme et de la coloration des individus? Qu'ils ne sont pas constants, qu'ils existent à un certain moment de la vie des bacilles pour disparaitre plus tard spontanément. J'appellerai au secours de mon témoigner celui de la commission royale anglaise et celui de la commission de l'office impérial allemand.

La mutabilité s'exerce donc largement parmi les bacilles qui ont élu domicile chez l'homme et chez le boeuf. Cependant les modifications qu'ils subissent en vivant dans une espèce ne se fixent pas d'une façon définitive. Les caractères que nous attribuons à l'hôte de l'homme et du boeuf sont rarement réalisées d'une manière complète. De sorte qu'il serait bien difficile à un bactériologiste, même très expérimenté, de prétendre déterminer sûrement l'origine des bacilles d'une série qui lui serai présentée.

Je n'inclinerai donc pas à la thèse de la dualité. Et les faits apportés devant le Congrès par MM. Jancso et A. Elfer, de Kolozsvar ne modifièrent mon opinion, attendu qu'après avoir proclamé que les 123 bacilles étudiés par eux correspondent exactement aux types humain, bovin et aviaire, ils déclarent à leur conclusion 6, que les bacilles d'un groupe peuvent varier dans beaucoup de leurs caractères et dans leur virulence, et à la conclusion 8, que les bacilles retirés de différents organes du même individu montrent des variations "immenses" au point de vue de leur caractères les plus importants. Impossible d'être plus transformistes que MM. Jancso et Elfer.

En résumé, la stabilité du bacille tuberculeux serait une exception dans le monde animal. Les types admis et défendus par plusieurs observateurs ne sont que des variétés et même des variétés temporaires qui se modifient tantôt dans l'une tantôt dans l'autre de leurs propriétés sous des influences naturelles ou expérimentales. En effet ces types sont rarement réalisés d'une façon parfaite, ils se fondent dans une série presqu'indéfinie d'individus qui, par leur végétation, leur forme, leur virulence, passent graduellement de l'un à

l'autre. La variabilité suffit à expliquer les caractères habituels de la virulence des bacilles de l'homme et du boeuf.

Si nous nous mettions d'accord une bonne fois pour le proclamer, nous nous mettions en garde contre tous les bacilles tuberculeux, et nous ferions cesser les malentendus qui nous obligent à discuter ici comme nous avons déjà discuté à plusieurs reprises depuis 1901.

Voyons la dernière facteur.

L'homme manque-t-il de réceptivité pour le bacille du boeuf?

On a cité à diverses reprises de nombreuses observations d'où il résulte (autant qu'on puisse l'affirmer lorsqu'il s'agit de cas cliniques) que la tuberculose bovine s'est transmise à l'homme par inoculation et par ingestion. Il serait fastidieux de les développer devant l'assemblée. Mais j'en signalerai un nouvel exemple que je dois à l'obligeance de M. le Dr. Gaultier, chef de clinique médicale à l'hotel-dieu de Paris. Ce cas s'est produit sous les yeux du professeur Lancereaux. Il est inédit.

Un homme de 55 ans, dépourvu de tare tuberculeuse ainsi que dans ses ascendants et ses descendants, est pris d'un mal de Bright. Sur traitement médical, on ajouta le régime lacté. Retiré dans une propriété à la campagne, il fait des cures successives de lait cru. La vacherie d'où prevenait le lait renfermait 14 bêtes tuberculeuses sur 18. Elle fut renouvelée. Mais le malade, dans les derniers mois de sa vie s'amaigrit considérablement et prit dans la région cervicale des ganglions volumineux dont la nature tuberculeuse fut nettement constatée.

Le fermier à son tour succomba de la tuberculose pulmonaire.

Cet exemple est très suggestif. Je sais qu'on peut le discuter comme tous les cas cliniques. Cependant il reste et nous avons autant de droit à l'invoquer qu'en ont nos adversaires.

Je sais aussi qu'on a parlé de la bénignité des inoculations cutanées. Mais cette bénignité retrouve au même degré dans les inoculations cutanées de bacilles humains, témoins les tubercules anatomiques dont la plupart disparaissent heureusement sans entrainer de généralisation.

Nous avons lu dans le rapport de M. Kossel, au Congrès de Paris, que le bacille bovin rencontrait dans l'organisme de l'homme un si mauvais terrain que s'il parvenait à s'implanter dans l'intestin, il ne sortait pas de cet organe ou des ganglions correspondants.

A l'appui de son hypothèse, il citait le fait d'un malade frappé de tuberculose intestinale et pulmonaire et chez qui les lésions de l'intestin renfermaient le bacille du boeuf et les lésions pulmonaires le bacille humain. Ce malade avait donc été victime de deux infections différentes dans la pensée de M. Kossel: l'une intestinale, due à l'ingestion du bacille bovin, l'autre pulmonaire due à l'inhalation du bacille humain.

J'opposerai simplement à cette hypothèse un fait personnel. Le bacille

humain le plus virulent que j'ai isolé, qui ne le cédait en rien au bacille bovin le plus actif, venait de la poitrine d'un malade dépourvu de tuberculose abdominale. Je l'opposerai aussi à M. Koch affirmant que l'on n'a jamais trouvé le bacille bovin dans la tuberculose du poumon. Cela me conduit à un ordre d'arguments dont on a fait état contre nous. Je veux parler de la rareté des lésions intestinales primitives.

Vous prétendez, nous disait-on, que l'ingestion de lait bacillaire est préoccupante; mais si elle était si redoutable, la tuberculose primitive de l'intestin serait très fréquente.

Nous répondons d'abord que les lésions intestinales, d'apparence primitive ne sont pas aussi rares qu'on l'a prétendu il y a cinq à six ans. Et ensuite, nous dirons, que l'introduction du bacille de Koch par les surfaces muqueuses est bien loin d'être toujours marquée par une lésion locale.

On croyait, il y a quelque vingt ans, que la tuberculose évahissait l'organisme de proche en proche, jalonnant sa route de ganglions lymphatiques tuberculeux. J'ai montré autrefois, sur le lapin, que le virus s'étendait de la face interne de la cuisse au poumon sans léser le système lymphatique, et sur le cobaye qu'il sortait rapidement de la zone d'insertion, avant l'établissement de lésions ganglionnaires. M'appuyant sur des expériences anciennes de mon maitre Chauveau, j'ai noté l'absence d'accident à la porte d'entrée à la suite de contamination digestive.

Depuis, cette question a été réétudiée par Calmette, par mes élèves Nicolas et Descor, par Fernand Arloing et par moi-même.

Des bacilles peuvent franchir la muqueuse intestinale, circuler sûrement avec la lymphe, peut-être avec le sang, parvenir dans le coeur, et de là être lancée dans les organes d'élection où ils disparaissent où bien réussirent à créer des lésions.

J'accepte néanmoins la création de lésions intestinales primitives, mais je ne la juge pas nécessaire, contrairement à certaines assertions antérieures. En conséquence, les tuberculoses pulmonaires qui ne s'accompagnent pas de tuberculose intestinale ne sont pas obligatoirement étrangères à une contamination digestive.

Actuellement, nous ne connaissons aucun moyen de déterminer sûrement et dans tous les cas la porte d'entrée du virus tuberculeux. Nous ne pouvons émettre sur cette question que des probabilités. Et certainement beaucoup de tuberculoses pulmonaires simples ou de tuberculoses chirurgicales ont eu pour origine une contamination digestive. Le contexte serait ne tenir aucun compte des travaux des vingt dernières années. Je crois avoir répondue à l'argument tiré de la localisation intestinale.

On nous a objecté aussi la rareté des contaminations en égard au nombre de bacilles que l'homme peut ingérer et au nombre des occasions où il peut les ingérer. Heureusement, il existe entre le virus tuberculeux et celui de

maladies outrement contagieuses des différences très grandes au point de vue de la diffusibilité qui nous expliquent que la tuberculose ne se propage pas comme la variole, la scarlatine et la rougeole.

De plus, le virus passant à travers le tube digestif perd une partie de son activité au contact du suc gastrique et de son pouvoir infectieux par sa dilution dans le contenu de l'estomac et de l'intestin.

En outre, la répétition des infections, à très petites doses auxquelles l'homme est soumis, à des intervalles irréguliers, confere probablement à ce dernier une certaine résistance. On en verra la preuve dans le nombre des sujets qui, avançant en âge, acquièrent de la sensibilité aux divers moyens révélateurs de la tuberculose. Ce sont là autant de raisons qui diminuent propagation de la tuberculose, ou gênent le développement de tuberculoses très graves en dépit des causes fréquentes de contamination. Et, malgré ces influences, nous savons par les anatomo-pathologistes qui se sont consacrés à cette recherche, que bien peu d'entre nous échappent à l'infection tuberculeuse.

La question importante se pose donc de distinguer parmi les nombreuses infections dont nous portons les traces celles qui relèvent du bacille bovin.

M. Koch a indiqué, il y a quelques années un moyen de les reconnaitre. Les lésions tuberculeuse est d'origine bovine lorsqu'elle contient un bacille capable de produire une généralisation sur le veau après insertion sous la peau.

C'est à l'aide de ce critérium que la Commission de l'office impérial allemand, la Commission royale anglaise, et des expérimentateurs isolés ont tenté de déterminer la fréquence des tuberculoses d'origine bovine.

En réunissant les moyennes de divers expérimentateurs, on arrive au chiffre très respectable de 7%, si j'ai bonne mémoire.

Si l'on en croyait M. Detre, d'après la mode de détermination qu'il a communiqué hier au Congrès, ce nombre atteindrait un chiffre bien plus élevé.

Je me hâte d'ajouter que je ne veux pas endosser la résponsabilité de ces chiffres. J'ai dit que je ne jugerai pas absolu le critérium indiqué par le Prof. Robert Koch, car il existe chez le boeuf beaucoup de bacilles dont l'action se borne à une infection locale. Quant au procédé de M. Detre, très interessant d'ailleurs, il demande peut-être une confirmation expérimentale, dans tous les cas, la sanction du temps.

Donc, je ne saurais dire dans quelle mesure la tuberculose bovine participe à la tuberculisation intestinale de l'homme. Mais je ne doute pas qu'elle joue un rôle plus ou moins important. Rien dans le nouvel exposé du professeur Koch n'est capable de modifier cette opinion.

Les conséquences hygiéniques se séduisent d'elles-mêmes.

Nous devons lutter, à l'aide des moyens révèlés par la science (M. Koch

a indiqué les principaux) contre la tuberculose bovine et les dangers qu'elle nous fait courir. Il est bien entendu qu'une lutte non moins énergique doit être dirigée contre la contagion inter-humaine. Jamais personne n'a prétendu qu'il fallait la négliger. Je ne me dissimule qu'à l'heure présente la lutte contre la tuberculose bovine se heurte à des obstacles d'ordre économiques très sérieux. Mais le devoir des hygiénistes est d'expresser la vérité scientifique, et de seconder les administrateurs dans le soin et de s'y confirmer autant que possible.

Si, après avoir mené le combat contre l'infection inter-humaine, nous fermions les yeux sur le danger de la tuberculose bovine, si même nous le traitions légèrement, nous serions trop fidèlement suivis par les intéressés et nous laisserons subsister une des sources de la contagion. Nous stériliserions donc les efforts dépensés dans la lutte gigantesque contre le fléau social qu'est le tuberculose.

INVESTIGATIONS OF THE RELATIONS OF HUMAN AND BOVINE TUBERCULOSIS AND THE TUBERCLE BACILLI.

By Johannes Fibiger and C. O. Jensen,
Copenhagen.

It is common knowledge that the first important communications on differences between bovine and human tubercle bacilli are due to American investigators, and, in the front rank of these, to Theobald Smith.

As early as 1896 and 1898 Theobald Smith called attention to the differences in morphology, biology, and pathogenic power existing between tubercle bacilli isolated from man and those from cattle. These remarkable investigations attracted merited attention only after the Congress in London, 1901, where Koch based his opinion, that man is very seldom infected by cattle, mainly on experiments similar, in reality, to those of American investigators—Dinwiddie, Frothingham, and especially Theobald Smith.

Now, however, the error of Koch's opinion being generally recognized, one does not forget that the transmissibility of bovine tuberculosis to man, just as pointed out by extensive investigations of recent years, establishes the fact that tubercle bacilli from cattle often possess a very high degree of virulence upon cattle, the pathogenic power of bacilli from man frequently being considerably less.

It being quite impossible to cite more than a fraction of this gigantic experimental work, I shall only remind you of the investigations of Theobald Smith, Arloing, Kossel, Weber and Heuss, Dammann and Müssemeier, the English Commission, Behring, Ravenel, Mohler and Washburn, de Jong, etc.

All recent investigators studying tubercle bacilli from man and cattle have found differences between the bacilli from these two sources. The differences, however, are not considered in the same way.

Theobald Smith, Ravenel, the investigators of the "Kaiserliches Gesundheitsamt," and a few others have divided all mammalian bacilli into two very distinct types or groups—one human, the other bovine.

The majority of investigators, however, do not consider the differences sufficiently pronounced and stable to justify the establishment of such a

division, pointing out that cultures which can be considered as intermediate types are to be found. The demarcation between the two groups or types is not a sharp one, some of the differences being very slight (the English Commission). The tubercle bacilli from man and from cattle are varieties or races of the same species (Arloing, de Gratia, Dammann, Rabinowitsch, etc.); though varying in qualities, they are identical (Behring, de Jong).

The problem of the relations between the human and bovine tubercle bacilli is not one of biological interest only. If the differences were sufficiently distinct and stable to be used in each case as safe criteria, the way would lie open for determining the extent to which the tuberculosis in man is due to contagion from cattle, and, vice versâ, to ascertain what importance is to be attributed, in the etiology of bovine tuberculosis, to contagion from man.

In the following I shall give a summary of some investigations, made in Copenhagen in the bacteriological laboratory of the Veterinary High School and in the Institute for Pathological Anatomy of the University, by Professor C. O. Jensen and myself. The investigations comprise studies of a series of tubercle bacilli, isolated from man or from cattle, and concern the virulence of the bacilli, their morphological and biological characters, the chemical reaction of glycerin bouillon cultures, etc.

Virulence for Cattle.—Altogether we tested upon cattle the virulence of bacilli from 29 cases of tuberculosis in man. It is unnecessary to give particulars of these cases, 12 cases having been published formerly,* and the other 17 about to be reported on. For details, these papers should be consulted, as only a few points will be mentioned here.

In 14 cases we used for inoculations pure cultures of the bacilli; in 6 cases both emulsion of tuberculous material and culture; in 9 cases emulsions† only. Subcutaneous injections were made in 26 cases, intraperitoneal in 2, and in one case the inoculation was made in the pleura. Cultures being used, the injected doses of bacilli were 5 centigrams. Forty-four calves and one cow, belonging to a stock absolutely free from tuberculosis, and, with very few exceptions, tested with tuberculin, were used.

Omitting one case‡—the virulence of which could not be positively determined, the injections with material and with cultures giving different results—we can divide the other cases into two groups.

One group, which I shall call *A*, consisted of 8 cases, all containing bacilli able to produce generalized tuberculosis in cattle in the same way as the bacilli most frequently found in spontaneous tuberculosis in cattle.

In 6 of these cases the patients were children (four months to seven

* Berliner klin. Wochenschrift, 1902, 1904, 1907.
† Most frequently from man; in some cases from inoculated guinea-pigs.
‡ A child five years old suffering from primary intestinal tuberculosis.

years old). In 5 children the tuberculosis was undoubtedly primary, and in one child it was probably primary in the intestines and mesenteric glands. Information on these cases has proved that 3 children had for a long time (two and one-half months to four years) been fed partly on raw milk, produced, in one case, from a very tuberculous stock and containing a cow with tuberculosis of the udder. In a fourth case the child had been partly fed, probably for a year, on unboiled milk, only warmed up.

I do not think it necessary to dwell in further detail on these cases, all of them having been published formerly, in proof of the error of Koch's opinions, in 1901.

In the seventh and eighth cases the patients were male adults. Judging from the autopsy, it is quite probable that the seventh was also a case of primary tuberculosis of the intestines. In the eighth case, which will be mentioned later, the patient was suffering from tuberculosis of the skin, the lungs, and the urogenitalia. The tuberculosis was primary in the skin of both hands and forearms, and had been contracted by butchering cattle. The bacilli from the cutaneous infection were quite pathogenic for cattle, the bacilli from the lungs and the urine, on the contrary, possessing only an extremely low degree of virulence.

The other group, which I shall call *B*, is made up of 20 cases of different kinds. Six patients were children, 14 adults. Primary abdominal tuberculosis was found in 1 child and 3 adults; generalized tuberculosis in 2 children, one of them showing grape-like peritoneal tubercles. In one case the bacilli were found only by inoculation of a guinea-pig with an apparently quite healthy mesenteric gland of a child without any tuberculous lesions ("latent" bacilli). In one case the patient, an adult female, was suffering from tuberculous mammæ. In ten others the patients were consumptive adults whose sputum had been used for isolating the cultures. In all these cases the bacilli possessed only a very low degree of virulence upon cattle or no virulence at all.

The results thus obtained by the study of the virulence of the bacilli from these 28 cases upon cattle may be summarized as follows:

1. Bacilli of marked virulence upon cattle were found (*a*) in the skin of a butcher who had contracted a cutaneous tuberculosis by direct inoculation of bovine tuberculosis in the skin; (*b*) in some cases in which the autopsies indicated that the bacilli had been introduced through the alimentary canal, the clinical histories, however, pointing out that the tuberculosis had been contracted by ingestion of cows' milk.

2. Only in cases in which the information pointed to a contagion from man were found bacilli with a virulence no greater than the virulence of bacilli usually found in human tuberculosis.

Thus, when bacilli strongly pathogenic for cattle, according to our

investigations and those of others (Gesundheitsamt, the English Commission, Smith, Ravenel, etc.), are found in cases of the first-mentioned kind, we think the conclusion admitted that the finding of bacilli with strong virulence upon cattle in human cases of tuberculosis indicates that the tuberculosis in such cases is due to bovine infection.

We cannot, however, admit the opposite inference, that human cases with bacilli of low virulence upon cattle must necessarily be due to infection from man. First, we must not forget that a high degree of virulence upon cattle is by no means an absolutely invariable quality of bacilli isolated from bovine tuberculosis. Further, it appears from Kleine's investigations on inoculated bovine tuberculosis in butchers that bovine bacilli, though of very slight virulence upon cattle, are able to produce tuberculosis in man—a fact indicating that the bovine origin of tubercle bacilli in man cannot in every case be positively determined by inoculation in cattle.

In the case of bovine tuberculosis of the skin mentioned before, a fatal tuberculosis of the lungs and urogenitalia developed after the disease of the skin had existed for some years. As far as known, the patient had not been exposed to infection from man. At the autopsy, besides tuberculosis in the lungs and urogenitalia, an old fibrous tuberculosis with single calcareous foci was found in the axillary glands. So it seems evident that we have a new aspect of bovine tuberculosis inoculated in the skin as giving rise to secondary tuberculosis.

As mentioned before, the bacilli from the lungs and the urine possessed, however, only a quite low pathogenic power for cattle, the bacilli of the skin, on the contrary, being very virulent. We have no doubt that the advocates of a sharp division between the bovine and human types will not hesitate to suppose, in this case, two infections—one in the skin with bovine bacilli, the other in the lungs with human bacilli—the more so as the bacilli were different in other qualities also, as will be shown in the following.

Of course, it is impossible to reject such an explanation. We think, however, that it is equally probable that the bacilli, having been spread from the skin to the lungs, gradually, in these and other organs, lost their original virulence upon cattle. At any rate, taking into consideration the results of Kleine, we cannot consider the avirulence of the bacilli as disproving their bovine origin.

In our opinion, only the fact that bovine bacilli with low virulence upon cattle can be found at times both in cattle and in man makes it impossible to constitute virulence upon cattle as a sharp demarcation between a human and a bovine type of mammalian tubercle bacilli.

Virulence for Rabbits.—Altogether, we have tested upon rabbits the virulence of 22 cultures—18 isolated from man, 4 isolated from cattle. One hundred and sixteen rabbits were used, most of them having been

inoculated intravenously with 1 to 2 mgm. bacilli or subcutaneously with 5 to 10 mgm.

Two cultures, isolated from 2 cases of primary intestinal tuberculosis of children infected with milk, were found—as was the culture from the bovine tuberculosis of the skin mentioned above—to possess a very strong virulence, producing, in the same way as the 4 cultures from cattle, fatal generalized tuberculosis—when inoculated intravenously, within thirteen to twenty-seven days; when inoculated subcutaneously, within forty to sixty-eight days. These cultures were also strongly virulent upon cattle. Nine cultures, on the contrary, were found to possess a very low virulence or no virulence at all upon rabbits, and a very low virulence upon cattle.

For the part of these 12 cultures, complete accordance thus was found between the virulence upon cattle and upon rabbits. According to virulence upon both species, the 3 cultures first mentioned could easily be placed in the bovine type and the 9 last mentioned in the human.

But this was not the case with the other 4 cultures, the virulence of which could be compared upon cattle and rabbits. Altogether, 35 rabbits were used in testing the virulence of these cultures, possessing only low virulence or no virulence upon cattle. Nevertheless, of the 35 animals which were used (2 to 4 for each culture), 14 rabbits (13 inoculated intravenously, 1 subcutaneously) died within twelve to fifty-three days of tuberculosis more or less generalized, in some animals miliary tubercles in masses being found in all organs. Though possessing only very low or no virulence upon cattle, these four cultures were found to be strongly virulent in some experiments, in others only slightly virulent, upon rabbits, the virulence upon the one species thus not being always in direct proportion to the virulence upon the other.

These experiments prove sufficiently that we cannot establish a sharp division between a human and a bovine type according to virulence upon rabbits. However, it deserves notice that the investigators of "Gesundheitsamt," in their latest experiments, have found that bacilli of the human type, when injected intravenously, even in the dose used by us (1 to 2 mgm.), can also at times produce acute generalized tuberculosis. The two types not being positively separable by such inoculations, only a dose of 0.01 mgm. is to be used. We are not able to base a judgment of this statement on our own experiments; but, considering that the bacilli of the human type, when injected intravenously in a dose of 5 to 10 mgm., according to Gesundheitsamt, can also produce at times a generalized tuberculosis in calves, we feel further justified in maintaining that it is impossible to carry out a sharp division between a human and a bovine type according to virulence upon cattle and rabbits.

Examining, in addition to these investigations, the anatomical effects of

the bacilli, we found the features absolutely identical, whether the case was due to infection from cattle or from man. Neither do the histological features present any differences; and it is deserving of notice that, in a single case of primary tuberculosis of the alimentary canal, infected by cows' milk, the tuberculous tissue was everywhere found to contain an extraordinarily small number of giant-cells only, and to almost consist of epithelioid cells with bacilli in masses.

The bacilli in our cases of bovine infection in children, when observed directly in the tissue, appeared quite different, presenting, in some cases, a short and plump appearance; in others, a long and slender one.

Morphological Examinations of Bacilli Cultivated on Glycerin Bouillon.—Studying the forms of the bacilli when cultivated, we examined 15 human and 13 bovine cultures on glycerin bouillon.

Undoubtedly, as pointed out by Theobald Smith, etc., most of the cultures isolated from man contain long and slender bacilli; while the membranes in cultures isolated from cattle are most frequently composed of short, plump, straight rods. This difference, however, is not always present. Among seven cultures isolated from human sputum we have, for instance, found one containing short and plump bacilli; and two cultures from cattle contained, when twenty days old, bacilli of the type usually found in human cultures. In other cultures it was difficult or impossible to decide the type accurately, and occasionally in the same culture amassments of bacilli could be found in the same preparation, some resembling the human, others the bovine, type.

More examples could be cited, but the references given prove sufficiently that we concur fully in the opinion of the authors who assert that the morphological differences which can be observed between the bacilli from man and from cattle are too inconstant and indistinct to be used as a sharp division between two well-characterized types, and even more so for a practically differential diagnosis.

Appearance of Cultures on Glycerin Bouillon.—Studying the differences in growth described by Theobald Smith, Gesundheitsamt, and others, we have compared the cultural characters of 29 bacilli isolated from man or cattle. Glycerin bouillon was used, having been prepared and inoculated under the same conditions. The cultures were compared weekly.

Summing up our results, we may, in the first place, confirm the well-known fact that bacilli from cattle grow, as a rule, with greater difficulty than bacilli from man. But we do not approve of a sharp division into two groups only. Our cultures can be placed in the following groups:

(*a*) Cultures which rapidly produce thick, wrinkled membranes covering completely the surface and extending, at the margin, up the sides of the flask.

(*b*) Cultures producing less rapidly moderately thick, wrinkled membranes, also ascending the sides of the flask.

(*c*) Cultures growing more slowly, producing granular, wrinkled, moderately thick, less coherent membranes, not extending over the surface.

(*d*) Cultures growing slowly, producing less wrinkled or smooth membranes, often incoherent and not extending over the surface.

In group (*a*) belong:
- 4 cultures isolated from *human sputum.*
- 3 cultures from the urine, the lung, and the testicle of the patient suffering from bovine tuberculosis of the skin.
- 1 culture from cattle, long cultivated.

In group (*b*) belong:
- 4 cultures from *cattle.*
- 1 culture from the case of bovine tuberculosis of the skin.
- 1 culture from a case of bovine tuberculosis of the skin, inoculated at the autopsy of a tuberculous cow.
- 1 culture from a case of primary tuberculosis of the alimentary canal of a child infected by cows' milk.
- 1 culture from "latent" bacilli in a mesenteric gland.

In group (*c*) belong:
- 2 cultures from *cattle.*
- 1 culture from a case of tuberculous mammæ in a woman.
- 1 culture from a case of pulmonary and intestinal tuberculosis in a child.

In group (*d*) belong:
- 4 cultures from *cattle.*
- 1 culture from a case of primary intestinal tuberculosis in a child infected by cows' milk.
- 3 cultures from *human sputum.*

In group (*a*), thus, principally belong cultures which, according to origin and virulence, may be considered as human; in group (*b*), on the contrary, are bovine cultures and cultures originally of bovine source, in addition to a culture the bovine origin of which could not be proved. In the groups (*c*) and (*d*), also, are placed cultures both of human and of bovine origin. No doubt, cultural differences are thus to be found. However, they are inconstant, influenced by circumstances, and can but be used arbitrarily in separating cultures into two groups only.

Chemical Reaction of Glycerin Bouillon Cultures.—In 1905 Theobald Smith added to the differences here noted a new one, the chemical reaction of glycerin bouillon cultures, in which, according to this investigator, the reaction curve of the bovine cultures steadily moves from the acid to the feebly alkaline level, where it remains; while in the human cultures, the original acidity, after having decreased for some time, again rises, but never becoming neutral or alkaline.

We have tested 17 of the cultures mentioned before by this method, as also a series of other cultures. Ordinary bouillon, not neutralized, prepared from fresh veal with 5 per cent. glycerin added, was used in flasks in layers 2 to 3 cm. deep. While the cultures were evaporating (sixty to seventy days) the reaction was tested at regular intervals (one to two weeks),

partly in examining successively a series of flasks of the same culture, partly in drawing fluid for titration from the same flasks fitted with siphons for drawing off. In the beginning the acidity was generally 0.5; that is, 100 c.c. having been neutralized with 5 c.c. $\frac{1}{10}$ normal alkali solution, phenolphthalein being the indicator. Sometimes the acidity was 6 to 7, rarely 7.2.

We found, as did Theobald Smith, considerable differences in the reaction curves, which we shall separate into three groups:

Group A.—The bacilli produced so much alkali that the acidity of the cultures after two to three weeks was only 1 to 2. Neutral or alkaline reactions not being found can easily be explained by the fact that the original acidity used by Theobald Smith was considerably lower than in our cultures. Thus, the alkali produced by the growth of the bacilli was (in the experiments of Theobald Smith, but not in ours) able to neutralize the quantity of acid.

Group B.—Cultures in which the acidity, having been reduced during ten to fourteen days to 2 to 3, rose again within three weeks to 5 to 6.5, afterward remained essentially unaltered. As stated by Theobald Smith, this acidity is somewhat greater.

Group C.—Cultures in which the acidity rises to 9 to 10, the chemical reaction for the rest going on in the same way. In 1907 Theobald Smith described such a group, stating that the human type may be separated into two groups, one producing twice as much acid as the other.

To group *A* belong 13 cultures isolated from cattle and 9 cultures isolated from man. Of these 9 cultures, 2 were isolated from cases of undoubtedly primary bovine infection in the alimentary canal of children, 1 from the often mentioned case of bovine tuberculosis of the skin in a butcher. Of the other 6, 3 were isolated from adult patients: in two cases from sputum, in one from a case of tuberculous mammæ. Three further cultures were isolated from children: one from an apparently healthy mesenteric gland ("latent" bacilli), another from a case of generalized tuberculosis, a third from a case of primary intestinal tuberculosis. Of the 9 cultures isolated from man, the first 3 mentioned were strongly virulent upon cattle and rabbits. Of the other 6 cultures, 5 were found to possess only very low or no virulence upon cattle—2 of these cultures being also slightly virulent upon rabbits, and 3 being found in some inoculations strongly, in others only slightly, virulent upon rabbits. In the sixth culture, isolated from primary intestinal tuberculosis in a child, the virulence was also found to change in inoculations upon cattle and rabbits.

To group *B* belong 5 cultures of human origin, of which 4 were isolated from sputum of adults, and 1 from a case of pulmonary and intestinal tuberculosis in a child. All cultures were avirulent or slightly virulent upon cattle.

To group *C* belong 2 cultures isolated from the urine and from the testicle of the butcher suffering from bovine tuberculosis of the skin, one culture iso-

lated from sputum of an adult, and also a culture found strongly virulent upon cattle, which had been isolated years ago from a case of primary intestinal tuberculosis in a child.

Summing up our results, we find that they confirm the statement of Theobald Smith, that some cultures, when cultivated on glycerin bouillon, are able to decompose the glycerin into acid, but not others. We do not, however, agree with Theobald Smith in his opinion that this fact is to be used as an absolute separation between the human and bovine types.

Admitting that the cultures isolated directly from cattle, as well as single cultures undoubtedly of bovine origin, though isolated from man, have produced alkali; and, further, that the majority of cultures isolated from human sputum have produced acid—we may, however, point out that at least one culture from sputum, being, according to virulence, of the human type, has produced alkali, but not acid, just as the bovine cultures; and, inversely, that a culture strongly virulent upon cattle is to be placed among the human bacilli producing most acid.

Lastly, a series of cultures, not positively bovine in type, according to virulence, and in morphological features corresponding to the human, has been found to produce alkali. Add to this that not 2, but at least 3, types are to be separated according to the reaction curves, and that the experiments of Mohler and Washburn go to show that, in tuberculosis in wild animals, bacilli can be found which, according to reaction curves, are not to be placed in the types mentioned, the reaction of the bouillon being very slightly changed.

The English Commission, confirming the statements of Theobald Smith, interprets the differences of the reaction curves only as quantitative, dependent directly on the amount of growth. In this opinion we cannot concur; though the bacilli producing acid grow quite rapidly, cultures growing as luxuriantly are to be found among the bacilli which do not produce acid. Further, as stated by O. Bang, the avian tubercle bacilli, though they grow rapidly, do not produce acid. We consider, with Theobald Smith, the differences of the reaction curves as indicating a really different faculty of utilizing the glycerin, with or without producing acid. Accordingly, we consider the differences as a valuable disproof of the sharp division between a human and bovine type, bacilli frequently being found in man showing all the usual qualities of human bacilli, but agreeing, in this particular, with the bovine.

Faculty of Growing on Substances Free from Albumin.—In addition to the experiments here mentioned, I shall briefly outline the results of investigations made by my collaborator, Prof. C. O. Jensen, concerning the faculty of growing on substances free from albumin and peptone 36 cultures of tubercle bacilli.

Prof. Jensen employed asparagin, alanin, or ammonic phosphate dissolved (2 per cent.) in an aqueous solution of the ashes of Cibil's extract of meat, added to glycerin (3 per cent.) or glucose (3 per cent.). The cultures tested can be placed in the following groups:

(*a*) *Cultures growing on these substrates nearly as well as on glycerin bouillon.* All these cultures were isolated from man, with one exception, which was obtained from a monkey.

(*b*) *Of these cultures, being unable to grow on the substrates,* 14 were isolated from cattle and 2 from man. These 2 cultures also were of bovine origin, having been obtained from cases of primary intestinal tuberculosis in children infected by cows' milk.

One could consider this result as pleading in favor of a sharp separation of the human and bovine types; but in group (*a*) one culture, quite virulent upon cattle, is to be found.

(*c*) *Cultures certainly growing on the substrates, but very scarcely.* In this group may be placed the culture (isolated from a case of primary intestinal tuberculosis) mentioned before, the virulence of which could not be stated positively, also two cultures also mentioned before, the one isolated from bovine tuberculosis in the skin of a butcher, the other isolated from the skin of a similar patient, suffering from cutaneous tuberculosis developed from lesions received at the autopsy of a tuberculous cow.

We consider the fact that the last two cultures, though bovine, are able to grow on substrates free from albumin, as indicating that the bovine bacilli, while living in the human body, can be modified and approach the type usually found in man.

Summarizing the results of our investigations, we agree with the authors who do not admit a sharp separation between two types only of mammalian tubercle bacilli. We admit that the majority of cultures isolated from cattle possess the qualities regarded as peculiar to "typus bovinus," and also that the greater number of cultures isolated from human sputum can be placed in the "typus humanus"; but there are some cultures remaining which are to be considered as transition forms, having some qualities common to the human, others to the bovine, type.

In order to decide the question of the relations of human and bovine tuberculosis and tubercle bacilli, it is necessary to devote more study in the future than we have hitherto done to the possibility of transforming the one so-called type into the other while living in the human body or in the tissues of the domestic animals.

RELATIONS OF HUMAN AND BOVINE TUBERCULOSIS.

By Mazyck P. Ravenel,

Madison, Wisconsin.

The practical side of this question has been emphasized this afternoon by Professor Koch and others. Certainly we all agree that this is what gives it its importance. I do not believe that any of us would have worked as hard as we have worked for this question, nor do I believe that the world in general would have taken so much interest in it, except for its practical value. On the correct solution of this question depends, no doubt, the health of many children and even their lives, and I would consider it an extreme misfortune, not only for this country, but for every country on the face of the earth, if any impression should go out from this meeting that even the small proportion of deaths due to the bovine bacillus was a negligible quantity.

Professor Koch has told us that, as far as he knows, never has the human type of bacillus been found in cattle. This, as far as we know, is the experience of us all. Of the two types, which have been so amply described this afternoon, I will not speak further.

The work of the State Live-stock Sanitary Board's report of Pennsylvania on this point at the London Congress in 1901 confirmed the experiments made previously by Dr. Theobald Smith quite fully. It is, of course, of interest to us to question how bacilli can be differentiated into two types. The explanation for this seems something like this: I assume that cattle in general have a certain resistance to tuberculosis, that resistance being greater perhaps than the resistance of animals like men. Therefore cattle are only susceptible to tubercle bacilli of high virulence. In other words, we have, so to speak, a biological filtration of the cultures by means of which the cultures of feeble virulence are destroyed by the mechanism of the animal's body, and the highly virulent type is retained. Therefore a partition is to be found which has filtered out the feebly virulent and gives us a type of higher virulence. This seems to be the best explanation I can think of for differentiating these species.

As a natural corollary of this theory it seems to me that what has been proved by the work of Jensen and Fibiger and by the work of the English

Commission is also true, namely, that this filtration is not absolutely exact. Some will retain only the most exceedingly virulent culture; others will retain a little less virulent, until we get on down to the human type. It has been demonstrated that we get all intermediate grades between the two types.

The title which has been given to me to-day has been slightly misinterpreted. What it should have been was the present status of the question as related to human and bovine tuberculosis. On account of the lateness of the hour, I will be very brief and give to you what seems to me the present state of affairs in regard to this great question.

We have proved at the laboratory of the State Live-stock Sanitary Board of Pennsylvania in the year 1901, and at the London Congress we for the first time in the world absolutely demonstrated, that the tissues of children dying of tuberculosis contained the bovine bacillus. Since that time our work has been confirmed by many men in this country, by the German Commission, by the English Royal Commission, and by Fibiger and Jensen; and, in fact, from every part of the world have come proofs of the work which we announced in the year 1902. In our own laboratory in the State Live-stock Sanitary Board of Pennsylvania this investigation has been repeated. Now the question is often brought up, "Why don't you cut it off?" It is perfectly true that if you take the whole sum and substance of the cases throughout the world, they are few as compared with the total number of deaths. That changes can take place; that we have no good method of absolutely distinguishing between the two, or at least that we cannot state absolutely the origin of any given culture that we get out, is absolutely true. In other words, this brings up the great question of the mutability—the change from the one type to the other in the human body. I believe this change can take place in culture. The tubercle bacillus is very tenacious of the type, of the characteristic. It is probably true of the body to a very great extent, although it is certainly not absolutely true. For instance, I have inoculated repeatedly bacilli of the bovine type absolutely characteristic in every respect; and if not recovered in culture, if examined in the tissue, you will find them beaded and stained exactly like human bacilli. I have also demonstrated that cows cough up sputum and distribute it exactly as human beings do, and in the sputum of such cows I have demonstrated the tubercle bacilli exactly corresponding to the human type. So I do not think that morphological differences observed in early cultures are extant in the tissues of animals.

One other thing has been proved through the work all over the world, namely, that the tubercle bacilli can pass through the intestinal wall and move through the mucous membrane of different parts of the body very rapidly without leaving any mark of their passage. Demonstrations have

shown that inside of four hours, in fact, inside of three and a half hours, tubercle bacilli have passed from the milk of animals through the thoracic duct and have reached the lungs in sufficient quantities to kill other animals inoculated. This has been carried out in a more approved way by Linevitch in Berlin, who took the extreme precaution of severing the esophagus of swine; tubercle bacilli then put into the milk of an animal, with no connection whatever between its milk and its mouth, will be found absorbed within from twenty-two to twenty-six hours.

We have given incidentally another proof along this line in some of the feeding experiments with monkeys, and we must admit that the monkey. approach man more closely than any other animal on the face of the earth, We have shown that animals which showed no intestinal lesion whatevers at least as far as we could find by microscopical examination, have diseased lungs. These specimens are familiar to many in this audience. They have been exhibited at Johns Hopkins University, before the American Medical Society and before the Academy of Medicine in New York, and before many other bodies, where the lungs of a monkey were absolutely riddled with the disease, while the intestines were absolutely free or showed the slightest lesion possible. This experiment has been shown many times. There are certain objections to them. We have taken this experiment, together with the experiment on guinea-pigs which we have made in the laboratory of the State Live-stock Sanitary Board, and the most perfect experiment which I have just quoted from Linevitch, of Berlin, as strong evidence that the tubercle bacilli go to the lungs at exactly the same rate that our food goes from the intestines through the large blood tract near the spine. It has been proved that tubercle bacilli, put into the stomachs of animals, have reached the lungs in large numbers. It has been said here to-day, and nobody has controverted it, that most of these cases occur in children. This of itself points to the intestinal tract as a gate of entry. In the proved cases cited by Dr. Fibiger, of children fed on the milk known to come from tuberculous cattle, there have been a striking number who have died from tuberculosis.

One other point has also been touched upon, namely, the action of bovine tubercle bacilli in producing cutaneous lesions. We have had the unique experience of having the assistants of the laboratory inoculated with the virus of bovine tuberculosis bacilli, and this same culture was compared with the original. We have had three infections in our laboratory, cutaneous infection by bovine tubercle bacilli, and they have acted in all respects like similar lesions in cattle. Bovine bacilli, having entered the human body, do not behave in the human body in the same way that the human bacilli do.

Let me sum up very briefly the condition of things as it appears to me

to-day. It cannot be controverted that there is a fair proportion of children and a few adults who have shown the bovine tubercle bacillus in lesions. The bovine bacillus is not infrequently found in the tonsils excised at various stages; and it is definitely proved that the tubercle bacillus will pass from the intestines into the lungs in a few hours.

Having demonstrated that there are a certain number of cases due to bovine tubercle bacillus; that a certain number of deaths occur from this bacillus; and having demonstrated that the tubercle bacillus passes into the stomach or gets there from some outside source, it behooves us, from every point of view, to take every precaution possible against contamination of our milk. I do not think it is possible, with our present knowledge, and it may be many years before we have sufficient knowledge to determine the number of cases due to the bovine bacillus as compared to those due to the human bacillus. There can be no doubt, I think, that at the present time the human phthisis is the phthisis that we must look at for the greatest number of victims. I cannot agree that the proportion of cases due to the bovine bacillus is insignificant. I emphasize the fact that, to stamp out this disease, both sides must be looked after. There is no use of keeping cats out if you are going to let the kittens get in. The kittens will grow to be cats, and therefore it is important to guard against tuberculosis in cattle, not only from the public health standpoint, but because it is a most serious economic question in almost every civilized country.

Dr. Pearson asked Prof. J. George Adami, of Montreal, to take the chair. Dr. Adami presided during the next three addresses.

THE SUSCEPTIBILITY OF CATTLE TO THE VIRUS OF SURGICAL FORMS OF HUMAN TUBERCULOSIS.

By R. R. Dinwiddie, M.D.,
Bacteriologist to the Arkansas Agricultural Experiment Station.

In the study of possible etiological relations between human and bovine tuberculosis by the experimental method, tests of the virulence of the sputum of human consumptives when inoculated into cattle, of which many have been made within the last decade, have led to fairly uniform results, establishing the fact that the sputum of human consumptives contains bacilli of lesser virulence for bovines than those derived from the tubercular lesions of cattle. Furthermore, I should say, basing the statement on my own experiments, that these bacilli of bovine origin are more virulent than those of human origin (from sputum), in a marked degree so for sheep, and also, although apparently in a lesser degree, more virulent for pigs. Rabbits also obtain a more rapidly progressive disease when inoculated with tubercular virus from the bovine. These are facts which are now well known to pathologists. I would also recall the fact that exceptional cases of human tuberculosis have been met with from which bacilli have been obtained possessing a high degree of virulence for bovines. It is now, therefore, I think, accepted by pathologists that in human tuberculosis strains or races of tubercle bacilli of varying degrees of virulence exist, so that the course of pulmonary tuberculosis or its sequelæ, slow or rapid, may be a result of either of these two factors—receptivity of the individual or virulence of the bacillus. Nevertheless, admitting this as an occasional occurrence, the fact remains that in the great majority of cases the sputum of human consumptives and cultures derived from the same do not occasion a progressive or permanent disease when inoculated into cattle subcutaneously or in the peritoneum, while bacilli of bovine origin injected by the latter method almost invariably do. In comparative tests of the effects of tubercular virus from man and from cattle on ruminants I would point out one source of error as it appears to me in arriving at a just estimate of the results. That is the premature dissection of the subject, by which we discover the immediate or proximate results of the inoculation, but lose the opportunity of studying the later or

ultimate effects. Now, the main difference, in my experience, lies in these latter. In cattle inoculated with bovine virus the lesions induced tend to be progressive and permanent, as in the natural disease, but with human, or at least sputum virus, the effects are usually temporary and tend to retrogression. The early effects may be rather severe, and occasionally even fatal, as some experimenters have found; but when survived, the lesions primarily induced undergo a healing or absorptive process and may finally be obliterated entirely.

Usually after intraperitoneal inoculation of sputum into calves a reaction to tuberculin can be obtained in a few weeks. I have seen it within three weeks. This indicates, I think, that an actual infection has taken place, with multiplication of tubercle bacilli within the body. After six months we will most commonly obtain no reaction to the tuberculin, indicating that active proliferation has ceased. Either the infection has been thrown off completely or it has become latent. I have seen instances of both of these occurrences in cattle and sheep one year after inoculation with sputum cultures—cases in which absolutely no lesions could be found, and in others a few minute calcareous foci in the mesenteric glands still containing living tubercle bacilli in small number.

I would also point out another feature which we have observed in sheep after inoculation with human sputum, and which I have referred to in previous reports. That is the occurrence of what I have called abortive miliary tubercles in the lungs. These may occur in two forms: (1) as minute, just visible, pearl-colored specks thickly distributed throughout the lungs, and consisting histologically of small round cells only, and (2) as small, round, calcareous bodies, less than a mustard-seed in size, inclosed in a thin capsule from which they are easily shelled out. In some of these latter tubercle bacilli have been found, apparently in a condition of latent life. These also were rather thickly distributed in the lung tissue of sheep and calves. Both of these lesions, evidently embolic in origin, show the slight adaptability of the tissues of ruminants to the growth of tubercle bacilli of human source. A generalization such as this of bovine tubercle bacilli would presumably have led to a fatal issue.

Morphology.—Bacilli present in the tubercular masses of cattle vary in shape. In ulcerative lung disease similar to phthisis of the human being—a condition which occasionally occurs—I have found in the few cases examined a complete similarity in shape to the bacilli of human sputum. In necrotic solid or semisolid débris of lymphatic glands in tuberculous cattle short, slender, solidly staining forms have been found which differ from the usual type of sputum bacilli both in size and in grouping, considerable numbers—20 to 50 or more—being packed together in close parallel apposition, so as to appear like almost solid masses. This, of course, is not a

common occurrence, the bacilli of bovine tuberculosis being usually present, or at least demonstrable, in relatively small number. Still, I have taken this feature—short forms and grouping referred to—as being the morphological characters to be looked for in any attempt to locate a bovine source of human infection by microscopical examination of the pathological lesions or discharges.

From this point of view, in the examination of specimens of sputum which have come to my laboratory in the past three or four years, none has been seen which possessed in any marked degree the features mentioned. Some, however, have shown slight differences from the common type of sputum bacilli, and one of these, in which there appeared to be an approach to the bovine type of morphology as assumed, was tested as to virulence by animal inoculations.

The history of this case as furnished by the attending physician was briefly as follows:

Male, aged thirty-eight, farmer; no family history of tuberculosis and no history of house infection; patient been affected for six months. Disease began as an empyema; location posterior part of left lung, followed by cough, hemoptysis, and night-sweats, which later improved. Little loss of weight and no indication of tubercular infection other than pulmonary. Has never had any enlarged or scrofulous glands.

Sputum from this case showed bacilli moderately numerous, mostly short, and arranged in groups resembling preparations from the bovine.

Inoculations.—A large guinea-pig receiving a subcutaneous inoculation of this sputum July 23, 1907, was killed after four months, and showed on dissection slight local lesions and a few small, translucent tubercles in lungs.

On the same date a calf fourteen months old received in the peritoneal cavity 5 c.c. of this sputum, now four days since collection. Following this inoculation no symptoms were exhibited and no febrile temperature at any time. The tuberculin test was applied in September, seven weeks after inoculation, and again in ten weeks, but no distinct reaction was obtained in either instance. The animal showed no effects of this inoculation during life, and on dissection one year later the only lesions found were several reddened, rough patches on omentum, and numerous very small, fibrous, tongue-like prolongations and fringes on the surface of the spleen. Caseation or tubercle bacilli not found.

These are the usual lesions in cattle resulting from sputum inoculations. The suspicion that this was a case of infection from the bovine was not confirmed by the inoculation test.

In human tuberculosis with localization other than pulmonary a possibility exists that the bacilli there represented may exhibit toward cattle a

degree of virulence different from that shown by cultures derived from sputum. The tubercular adenitis characteristic of the condition which has been designated scrofula, especially, differs in its course from other forms of tuberculosis. The slow or non-progressive course of these infections has been ascribed by writers to both deficiency in virulence and in number of the bacilli present. One writer* advanced the interesting theory that scrofula is the manifestation of the bovine disease in man.

From human tuberculosis other than pulmonary the following inoculation tests have been made as occasion offered during the last few years.

TubercularArthritis.—The material consisted of purulent fluid from the knee-joint of a youth, the seat of disease for over a year, the bones of the joint being enlarged and spongy. Tubercle bacilli rare; usual morphology.

June 14, 1904: Guinea-pig (weighing 682 gm.) inoculated subcutaneously with one drop of this material. It was killed for dissection October 3d (weight, 658 gm., and in fair condition). The liver contained many hard, white nodules from size of rape-seed to that of a pea, with thick, purulent center, while the spleen and lungs showed a number of gray, translucent tubercles.

Cultures on serum were obtained from the spleen. From the purulent nodules in the liver, in which tubercle bacilli were sparsely distributed, inoculations were made to a guinea-pig, a rabbit, and a Belgian hare.

The guinea-pig died from some extraneous cause three weeks later.

The rabbit (weighing 1435 gm.) was inoculated in peritoneum. At the end of a year following the inoculation it was still alive and apparently well, but died three weeks later. Dissection showed local tubercular lymph-glands and a caseous nodule in the liver; other organs normal.

The Belgian hare was also inoculated in the peritoneal cavity. It remained in apparent health for four months. Its death, which occurred at that time, was not attributed to tuberculosis, since no lesions were found except two pinhead-sized, yellow, calcareous nodules in the liver in which tubercle bacilli could not be found. Evidently the Belgian hare is as little susceptible to human tubercular virus as the rabbit.

Inoculations of cultures obtained from the first guinea-pig were made to cattle, sheep, and pigs, one of each, the injection in each case being made into the peritoneal cavity. A guinea-pig weighing 806 gm. was also inoculated subcutaneously with a small dose. It died in fifteen weeks with extensive tubercular disease in liver, spleen, and lung, indicating a culture of the usual degree of virulence for this species.

January 3, 1905: Inoculations made from the second transfer on glycerin-beef serum; a large, typical growth (typical of sputum cultures) seventeen

* Creighton: Jour. Anat. and Physiol., 1880, 1881, p. 1.

days old. A pinhead-sized piece broken up in sterile water was injected into the peritoneal cavity of each animal—calf, sheep, and hog.

The calf (about nine months old) gave a doubtful reaction to tuberculin after two months, and again in the fourth month the reaction was uncertain (highest temperature, 103.6° F.). Killed for dissection on July 12th, that is, six months after inoculation, it showed the following changes: Omentum shows rough red patches of short and longer fringes; two flat, pendant nodules 1 cm. in diameter and yellow at margin on the surface of the rumen. Fringes over a hand's-breadth on surface of one lung and adjacent costal pleura. Very slight fringe formation on surface of spleen. No involvement of lymph-glands nor other changes found except those mentioned.

A spring lamb, probably about ten months old, similarly inoculated, was killed in four months, when obviously in a dying condition. Up till the last week it was apparently in good health. Dissection showed on the omentum, on the spleen capsule, and on the serosa of the gut a moderately numerous distribution of yellow, calcareous nodules the size of a pinhead or less. The animal was enormously infested with œsophagostoma nodules in the wall of the intestine, and even in the mesenteric glands, but some of these glands were apparently also tubercular. No other tubercular lesions were found, and the cause of death remained uncertain. Nodules of the serosa showed tubercle bacilli in groups and mostly short forms.

In the hog, also killed at the end of six months, when apparently in health, a few small rough areas and three or four seed-like nodules were found on omentum. Surface of spleen roughened by fringes all over the capsule. These are quite small and do not show tubercles. All the other organs, including lymph-glands, are unaffected. The disease seems to have been local. The roughened patches on omentum, when examined by the lens, show minute yellow tubercles. These are seed-like and are cysts containing each a calcareous particle. Tubercle bacilli, both long and short forms, are readily demonstrated.

The conclusion to be derived from this experiment is that the bacilli present in this case of tubercular arthritis correspond in their effects upon animals with those usually present in the sputum of pulmonary tuberculosis. There is no evidence of a bovine origin here.

After this rather lengthy record the remaining tests can be given briefly.

Genito-urinary Tuberculosis.—One case in which tubercle bacilli of usual form were present in large number in the urine of an adult. Tested on the guinea-pig and rabbit (directly, without cultures), the results were such as we obtain from sputum—extensive generalized disease in the former, slight and mainly local lesions in the latter.

Tubercular Glands of Neck.—In two cases inoculations were made directly from the caseous material into the peritoneal cavity of calves. In one

sample tubercle bacilli were found in very small number; in the other, they could not be demonstrated by the microscope, but the case proved tubercular by infection of the guinea-pig. Neither of these cattle reacted to the tuberculin test, and remained in apparent health till dissected, eight months later. At the autopsy no lesions of any kind were found. As to the virulence of the bacilli present, a guinea-pig weighing 400 gm., inoculated from one specimen, when killed four months later showed no loss of weight. The tubercular changes consisted of several enlarged, hard, caseous lymph-nodes at site of inoculation and one beneath the spine in the lumbar region. In the lung there were a few translucent spots, hardly recognizable as tubercles; other organs normal. In the local lymph-nodes tubercle bacilli were present, though not numerous; short forms predominating. Either from deficient number or feeble virulence, the effect on this animal was but slight.

From the local caseous glands of this guinea-pig a second weighing 614 gm. was inoculated subcutaneously. It died in a condition of emaciation at the end of six months, showing generalized tuberculosis with yellow nodules crowded in spleen, liver, and lung.

The results of these inoculations from scrofulous glands, on account of the scarcity of the contained bacilli, can hardly be considered conclusive as to their effects on cattle. I publish them rather to arouse interest in this matter in others who may be more favorably situated for making such experiments. So far as they go, they furnish no indication that scrofulous glands are of bovine origin, but they require repetition with cultures, by which larger doses may be injected.

The object in view in making such experiments is, of course, to throw some light on the mooted question of human infection from the bovine. With all that has been written on this subject during the last decade I contend, and I think many will agree with me, that the question is still in the speculative stage.

TUBERCULOUS CERVICAL ADENITIS.

A STUDY OF THE TUBERCLE BACILLI CULTIVATED FROM FIFTEEN CONSECUTIVE CASES.

By Paul A. Lewis, M.D.,
From the Laboratory of Comparative Pathology, Harvard Medical School.

The study I wish to report on here in a preliminary way was begun on the first of February, 1907. It was thought at that time by Dr. Theobald Smith that there was adequate recognition, among workers in this special field, of the definite distinction between tubercle bacilli of the human and bovine type, and of the proposition that the bacilli cultivated from a certain small number of cases of human tuberculosis were typically bovine in character; that presumably the human being had become infected from the bovine in these cases and in no others. In the work done up to that time effort had been directed toward the discovery of instances of this type of infection. It had been shown that these relatively rare cases were never cases of chronic pulmonary tuberculosis; that they were most usually cases of infection by way of the intestinal tract in children, particularly cases of mesenteric lymph-node diseases. Several cultivations from the cervical lymph-nodes had likewise given bacilli of bovine type.

It was felt that the time had come when it was possible and advisable to attempt to get definite statistical evidence as to the frequency of the infection of human beings with the bovine type of tubercle bacillus, that the technic had been developed to such a point that the work was feasible, and that the most profitable point of immediate attack would be in the field of cervical lymphatic gland infection—an important, rather frequent disease in any community, one which had been little studied from this point of view, and a field in which a certain percentage of bovine infections might confidently be expected to occur.

Accordingly, at the suggestion of Dr. Smith, and under his immediate supervision, I undertook to study a consecutive series of cases of tuberculous cervical adenitis, with the aim of determining the type of bacillus active in

each case. My sincere thanks are offered to Professor Smith for the initial suggestion and for the unceasing advice and attention which have made it possible for me, a beginner in this difficult work, to arrive in relatively short time at a classification of the cultures from a considerable number of cases.

Literature.—Most of my audience are doubtless familiar with the literature of this subject, and my review may properly be very brief.

In the general series of cases from the German Imperial Health Office there are reported four cases of primary cervical adenitis, two of which were due to bacilli of bovine type.

Smith has described three cultures of bovine type isolated from tonsils in cases in which the cervical lymph-nodes were probably also infected. The report of the English Commission shows that nine of their cultures were derived from cervical glands. Three of them were of bovine type.

Recently Oehlecker, of the German Imperial Health Office, has reported on isolations from fourteen consecutive cases of primary cervical adenitis. Two were in adults, both infections being of human type. Twelve cases in children yielded four cultures of the bovine type.

Certain other cases of isolation from cervical glands in cases of generalized fatal tuberculosis have been reported whose bearing on this question is not clear.

With the exception of the work of Oehlecker, the results so far reported have been too fragmentary to be worked into satisfactory statistical evidence, but it would seem probable from his results, taken with the instances reported by others, that about one-third of the cases of primary cervical adenitis are due to bacilli of bovine type.

Methods.—The material for this study has come to my hand without selection, through the kindness of the staff and house physicians of the Children's Hospital, Boston, and the Boston City Hospital. It has been material removed at operation without exception. I have received it in moist gauze from the operating room, as a rule. But in no case have I been able to control its manipulation absolutely, and I am obliged to assume as a probability that there has been no contamination with other tuberculous material before it reached my hands.

As soon as possible after receiving the material, guinea-pigs were inoculated with it. After three to five weeks cultures were made from the guinea-pig. First cultures were always made on Dorset's egg medium, and these were uniformly successful; in each case in which the guinea-pigs became tuberculous I have obtained cultures on the egg medium. Subsequently transfers have been made, at intervals of three to six weeks, to parallel series of egg medium and glycerin-agar. After the glycerin-agar culture has become thoroughly established in any case, I have discontinued the series on the egg medium. The glycerin-agar culture, whenever it has been possible

to obtain it, has been as the stock culture, subsequent transfers and most inoculations having been made from this medium. In two instances, however, the egg medium is still in use. After over a year of cultivation no glycerin-agar cultures have been obtained. Dog serum has not been used routinely because of a local difficulty in obtaining a regular supply.

After an active growth has been established with any culture it has been tested as to its growth on glycerin bouillon and the changes in reaction which it might bring about. The virulence for rabbits has been determined. Three of the cultures have also been tested as to their virulence for calves; in the other cases it has been assumed that the virulence for rabbits was a satisfactory indication of the virulence for cattle.

General Summary of Results.—I have thus examined 17 cases of cervical adenitis. In two cases the guinea-pigs failed to develop tuberculosis, although microscopical examination of the tissues showed the pathological picture of tuberculosis, in one case most typically. The fifteen cases in which tuberculosis developed in the guinea-pig all gave positive cultures.

The virulence of these cultures for rabbits has been determined, with the following results:

Each culture was inoculated intravenously into a rabbit in dose of 0.5 c.c. of a standard suspension, corresponding roughly to 0.5 mgm. of culture. Nine cultures killed in from two to three weeks with generalized tuberculosis. Six cultures did not kill. The animals ultimately gained in weight, were killed after two to four months, and showed a small to moderate grade of localized chronic tuberculosis. Several of the nine cultures which killed were retested in the same dose to exclude the possibility of accidental, coincidental disease. The result was as before. Finally, each of the nine virulent cultures was inoculated intravenously in $\frac{1}{100}$ of the standard dose, corresponding to $\frac{1}{200}$ mg. of culture. This dose killed in several instances in less than twenty-five days; eight of the animals were dead by the fortieth day. The ninth rabbit survived three months. It was at that time failing rapidly, was killed, and found to have an active generalized progressive tuberculosis.

Nine of the fifteen cultures are then found to be virulent for rabbits. It has been abundantly shown that it is safe to assume a corresponding virulence for cattle. However, three of these cultures which attracted our attention by reason of apparent cultural peculiarities were tested on calves. Three calves were inoculated intravenously with 5 mgm. of these three cultures respectively. All died in less than three weeks. One calf was inoculated in each case with 5 cg. of culture subcutaneously. These experiments are unfinished, but the animals seem certainly to be suffering from generalized tuberculosis at present, six weeks after inoculation.

To compare these virulence tests with cultural characters: The six

cultures which failed to kill rabbits were in each instance transferred at the first subculture to glycerin-agar, and grew from the beginning on this medium luxuriantly. They were as easily transferred to glycerin bouillon, growing for the most part with a heavy membrane which spread slowly and thickened markedly as rapidly as it spread. Titrations according to the method of Theobald Smith with 5 per cent. glycerin bouillon show that five of these six cultures produce a highly acid reaction at the end. The sixth culture has given an alkaline end-reaction up to the present time, and apparently corresponds to a culture isolated by Dr. Ravenel some years ago.

The nine cultures virulent for rabbits have shown a very variable adaptability to culture-medium. Subcultured each month to six weeks, I give the number of the subculture at which they have attained practically the luxuriance of growth of the non-virulent cultures as an index of their adaptability. Four cultures grew at once on glycerin-agar, and at the third subculture were as vigorous as the others. Three cultures failed to grow on the first glycerin-agar transfer and required from five to eight subcultures to reach maximum vigor. Two cultures, one eighteen months old, the other a year old, in spite of repeated trials, still refuse to grow on glycerin-agar. The more recent of these promises soon to give growth; the older so far shows no evidence of adaptation.

The growth on glycerin-agar has been a fair index of the possibility of obtaining growth on glycerin bouillon. It will be understood on this account that there has so far been no possibility of satisfactorily determining the reaction curve of all of these cultures. I have, however, encountered no convincing exception to the rule laid down by Theobald Smith, that the virulent cultures approach the neutral point as the end-reaction after forty to sixty days.

It seems safe at this time to say that the nine cultures of lesser adaptability and high virulence are of bovine type; the six cultures which readily adapt themselves to glycerin-agar and which have low virulence for rabbits are of human type. The interesting question may be raised as to whether the one avirulent culture which is marked off from its fellows by a failure to produce acid is not a bovine type modified as to its virulence and adaptability.

A careful study of such clinical and pathological data as I have been able to gather in connection with these cases has shown no feature of distinction in regard to pathological picture, number of bacilli present, duration of disease, family history, previous history, or present condition of the patients. There is, however, a striking difference in the average age of the patients. The average age of eight of the patients giving bovine type of bacillus was eight and a half years. The youngest was eighteen months and the oldest

nineteen years. The average age of the six patients suffering from infection with the human type of bacillus was seventeen and two-thirds years, the oldest thirty-two years, the youngest eight years. Of the cases of cervical gland disease in persons over fifteen years of age, four-fifths are infections with human type. Of the cases in persons below fifteen years of age, seven-ninths are of bovine type. The bovine type of infection would seem to be more common in children, the human in young adults, although the limitation is not an absolute one.

In closing, it is perhaps not out of place to express the hope that the work so far accomplished in this direction, taken with the detailed work of a consecutive character which the future may bring forth, may render it possible to replace by statistical data the somewhat contradictory current opinions as to the transmissibility of bovine tuberculosis to man.

THE TYPES OF TUBERCLE BACILLI PRESENT IN EIGHTY-FOUR CASES OF HUMAN TUBERCULOSIS IN NEW YORK CITY.

By William H. Park,

Director of the Research Laboratories of the Department of Health.

This is a preliminary report of an investigation carried out in the Research Laboratory of the Department of Health of New York City by four investigators working under my direction, namely, Dr. Chas. Krumweide, Dr. Wm. H. Woglom, Dr. Frederick Montgomery, and Dr. Elise L'Esprance.*

These investigations are to be continued until about four hundred cases of pulmonary tuberculosis in adults and one hundred cases of other forms of tuberculosis in children have been examined.

In all the cultures from these cases the character of growth upon egg and glycerin-egg media, and the virulence of carefully weighed amounts in rabbits, have been determined. It is thought that, although the culture tests are limited, they are, nevertheless, sufficient to indicate correctly the type of the bacilli, and thus add to the general information being collected from various sources. The methods adopted and the results obtained are summarized in the following pages.

Methods of Isolation.—No direct cultures were attempted. All material was injected into guinea-pigs which were allowed to live from three to five weeks. At the end of this period the tubercular organs were removed and thoroughly minced with knife and forceps. This minced tissue was then smeared over the surface of the culture-tube. This mincing and rubbing of the material over the culture-media we have found preferable to simply cutting the tissue, laying on the surface of the media, and subsequently

* The salaries of these investigators were paid from an appropriation made by the city for the study of respiratory diseases. This was obtained through the efforts of Dr. H. M. Biggs, Medical Officer. There has already been published an investigation upon acute pneumonia and upon pneumococci. This investigation was undertaken with the approval of Dr. Biggs and other New York city members of the commission appointed to study respiratory diseases.

moving to spread the growth, as advised by Theobald Smith. The second opening of the tube, a fruitful source of contamination with molds, is avoided, and the final growth is equal and greater in amount.

Methods of Cultivation.—Egg media of two types have been used for isolation and further cultivation. The ease and simplicity of preparation and the uniformity of the final product make other media for isolation superfluous.

The egg media were made as follows: Plain egg (Dorset): the whole egg was mixed with 10 per cent. by weight of water, inspissated at 70° C. for two hours, and a few drops of sterile water added to each tube to provide the necessary moisture. Glycerin egg (Lubenau) consisted of ten eggs mixed with 200 c.c. of 5 per cent. glycerin bouillon, 1.5 per cent. acid to phenolphthalein.

Other media, as glycerin-agar, glycerin bouillon, and glycerin-potato, were also used to determine the cultural characteristics and for further cultivation. The glycerin-potato has been the most uniformly successful as a stock medium for further cultivation. The cotton stoppers in each case, with or without dipping in paraffin, were pushed down the tube, which was then closed with a tight-fitting charred cork and incubated in the inclined position.

All cultures so far isolated have fallen into two distinct groups—eugonic (luxuriant) and dysgonic (sparse). This difference is noticed on plain egg, but to a less marked degree than on glycerin-egg. Here the influence of glycerin on the growth of the two types, as noticed by several investigators and carefully elaborated by Cobbett, causes a wide gap in the amount and rapidity of growth of the two types. The disgonic type commonly fails to grow in glycerin-egg from animal tissue, and if transplanted from plain egg after the first or second generation, grows but sparsely. The growth consists of thin, flat, spreading colonies, 1 to 2 mm. in diameter, or a confluent, thin, flat, slightly granular, non-pigmented layer, which is usually moist. The eugonic type, on the other hand, grows luxuriantly in most instances on glycerin-egg, directly from the animal tissue, and in every case in the second or third generation. The growth is confluent, raised, crumpled, or coarsely verrucose, dry, and in practically every case shows a pink pigmentation in some generations. The pink color depends on certain unknown differences in the different batches of media.

The other media used, as glycerin-agar, potato, and bouillon, we have found mainly of value as corroboration of the above differences, for the following reason: The eugonic strains grow luxuriantly upon these media, usually in the second generation, and always in the third or fourth. The dysgonic strains, on the other hand, usually fail to grow in the early generations; or if they do, the growth is very slight.

The differences in the growth of the two types as given only apply to the first few generations, and to cultures which are three weeks old, the rapidity of growth as well as the amount being an important factor. In later generations and with longer periods of incubation the differences are not so marked. We have not had the strains in cultivation long enough to be able to say if this difference will eventually disappear.

This division into dysgonic and eugonic viruses has been found in every case to correspond with the differences in virulence in rabbits.

Rabbit Virulence.—In the following description of this branch of the work the term "virulent" is applied to such viruses as are able, after intravenous inoculation in amounts of 0.01 mg., to induce a generalized progressive tuberculosis, terminating in the death of the rabbit within a period of six weeks.

The bacilli are removed from the surface of a subculture which is less than one month old, and the excess of moisture removed by gentle pressure between sterile filter-papers before the mass is weighed. The culture-medium used for these subcultures has been glycerin-egg and there have been added to the tubes, after coagulation of the medium, a few drops of glycerin bouillon. The growth immediately above the fluid can be readily and perfectly emulsified. After weighing, the bacterial mass is emulsified in physiological salt solution, which is added in such amount that 1 c.c. of emulsion represents 1 mgm. of organisms. The dysgonic viruses afforded too little growth for weighing. An emulsion was therefore made and compared with a known emulsion from a eugonic virus, the comparison consisting in the equal ease with which print could be read through each emulsion. Where a dose of 0.01 mgm. is desired, the original emulsion is diluted. The amount of fluid inoculated is always 1 c.c. The intravenous route was decided upon as the most suitable for our purpose, and it has been adhered to throughout the experiment.

It soon became evident that we had to deal with two, and only two, varieties of organisms, one of which far exceeds its fellow in virulence. In no case have we observed the slightest deviation from this condition; we have seen, that is, no strains of intermediate virulence for rabbits. Nor have we yet seen an exception to the rule that viruses whose growth is dysgonic on glycerin-egg are virulent for rabbits, while all the other strains are almost, if not quite, non-virulent.

An animal inoculated intravenously with 1 mgm. or with 0.01 mgm. of bacilli of the bovine type soon becomes emaciated, the fur loses its luster, respiration becomes labored, and death occurs in from nineteen to forty-two days, with an average period of twenty-eight days. Autopsy reveals extreme emaciation and a generalized tuberculosis involving almost every structure in the body. The lesions in the lymph-nodes, and of these particularly the inguinal

and the axillary, are characteristic. The nodes are enlarged, congested, and studded with minute caseous areas. The spleen is always three or four times its normal size and riddled with tubercles, and the kidneys are sure to contain on their surfaces an average of from six to ten tubercles each. The liver, on the contrary, rarely contains demonstrable microscopical tubercles. The lymph-nodes of the abdomen are usually enlarged, as are those of the thorax, but they do not, as a rule, present the characteristic lesions of the superficial group. The lungs are always entirely consolidated, and are literally a mass of tubercles. Tubercles in the heart muscle are not infrequent. The extent of the lesions and the duration of the illness seem to be rather a matter of individual resistance than of dosage. Thus, it is no uncommon occurrence for the rabbit which received 0.01 mg. to die several days before the one which, at the same time, had been given 1 mgm. of the same virus. Nor does it seem that old rabbits are more resistant than young ones.

Separated from such viruses by a wide interval of virulence are the eugonic viruses. These never cause generalized progressive lesions in doses of 1 mgm., and a rabbit so inoculated will live until carried off by an intercurrent malady. The appearance at autopsy is in striking contrast to the findings described in the preceding paragraph. The animal will be found well provided with subcutaneous and abdominal fat, and the lymph-nodes are normal in size and appearance. The appearance of the lungs varies with the length of time that has elapsed since inoculation. About six weeks after injection they are pretty extensively involved, for at this point, of course, many of the inoculated organisms are arrested. But that the lesions under discussion are regressive is shown by the fact that the animal has gained weight, as well as by our observation that in rabbits autopsied after an interval of three or four months the lungs are pink, well collapsed, and with tubercles only sparingly distributed throughout them. Almost always there are a few tubercles in the kidneys. The spleen is invariably of normal size and occasionally a tubercle may be found on its surface. Tubercles in the heart muscle are quite uniformly absent. Rarely, after a long interval, there occurs a tubercular orchitis. In rabbits which have, some time after inoculation, lost weight and eventually died, there has always been an adequate cause for death, other than tuberculosis. This, in most of our rabbits, has been either coccidiosis or septicemia.

The following tables show the material investigated and the type of organism isolated. The viruses are said to be of the human type when they are eugonic and non-virulent for rabbits; of the bovine type, when the reverse is true.

PULMONARY TUBERCULOSIS, ADULTS.

Name.	Age.	Number and Source of Culture.	Type.
A. K	17 yrs.	No. 5, Sputum.	Human.
J. W.....	22 "	" 9, "	"
M. S.....	Adult.	" 10, "	"
M. S.....	16 yrs.	" 11, "	"
R. R.....	Adult.	" 13, "	"
M. V.....	24 yrs.	" 22, "	"
W. E.....	Adult.	" 26, "	"
A. M.....	38 yrs.	" 27, "	"
C. K.....	Adult.	" 32, "	"
H. W.....	Adult.	" 34, "	"
A. M.....	30 yrs.	" 35, "	"
A. S.....	Adult.	" 36, "	"
B. P.....	Adult.	" 38, "	"
J. H.....	24 yrs.	" 39, "	"
J. W.....	Adult.	" 42, "	"
E. K.....	39 yrs.	" 44, "	"
L. T.....	40 "	" 46, "	"
M. F.....	Adult.	" 47, "	"
W. B.....	29 yrs.	" 48, "	"
J. G.....	30 "	" 51, "	"
.....	Adult.	" 59, "	"
D. D.....	45 yrs.	" 60, "	"
T. W.....	20 "	" 64, Tonsils and adenoids; 125,* Sputum	"
S. T.....	19 "	" 75, Sputum.	"
A. D.....	21 "	" 76, "	"
M. S.....	18 "	" 77, "	"
C. H.....	36 "	" 81, "	"
E. B.....	29 "	" 82, "	"
C. B.....	34 "	" 85, "	"
M. L.....	30 "	" 86, "	"
M. Y.....	28 "	" 87, "	"
H. S.....	29 "	" 88, "	"
A. F.....	58 "	" 90, "	"
A. N.....	Adult.	" 92, "	"
H. H.....	20 yrs.	" 101, "	"
M. G.....	29 "	" 102, "	"
H. C.....	25 "	" 103, "	"
M. M.....	23 "	" 105, "	"
L. C.....	24 "	" 106, "	"
P. Z	22 "	" 108, "	"
S. J.....	23 yrs.	" 112, "	"
M. R.....	17 "	" 117, "	"
R. R.....	33 "	" 119, "	"
J. W.....	22 "	" 126, "	"
I. W.....	42 "	" 128, "	"
J. D.....	18 "	" 133, "	"
R. H.....	27 "	" 134, "	"
F. O.....	18 "	" 136, "	"
P. McC.....	23 "	" 219, "	"
J. C.....	27 "	" 220, "	"
A. H.....	38 "	" 221, "	"
R. L.....	30 "	" 222, "	"
J. K.....	29 "	" 240, "	"
L. E.....	26 "	" 252, "	"
J. C.....	39 "	" 253, "	"

Total cases.....55 { Bovine type..... 0
Human type.....55

* Not finished in rabbits, but culturally human type.

PULMONARY TUBERCULOSIS, INFANTS.

Name.	Age.	Number and Source of Culture.	Type.
E. B.....	11 mos.	No. 15, Sputum.	Human.

Note: For other cultures from pulmonary lesions see under Generalized Tuberculosis.

TUBERCULAR ADENITIS.

Name.	Age.	Number and Source of Culture.	Type.
F. F.....	14 yrs.	No. 7, Cervical nodes.	Human.
C. S.....	4½ "	" 28, " "	"
L. D.....	12 "	" 29, " "	"
S. H.....	20 "	" 31, " "	"
E. H.....	6 "	" 67, " "	"
H. B.....	8 "	" 94, " "	"
M. Z.....	9 "	" 95, " "	"
Baby.....	21 mos.	" 96, " "	Bovine.
C. F.....	2 yrs.	" 116, " "	Human.
J. C.....	10 "	" 150, " "	"
M. L.....	6 "	" 155, " "	"
M. McC.....	10 "	" 201 and (162 *) " " both sides.	"
L. S.....	4½ "	" 167, " "	"
G. T.....	12 "	" 205, " "	"
A. A.....	4 "	" 217, " "	Bovine.
C. L.....	15½ "	" 247, " "	"

Total cases ..... 16 { Bovine type..... 3; Human type..... 13 }

Note: The percentage of bovine types will be much higher, probably about 30 per cent., when the viruses at present in cultivation have been tested in rabbits, as many of our later cases are culturally of the bovine type.

* Not finished in rabbits, but culturally human type.

GENERALIZED TUBERCULOSIS, INFANTS.

Name.	Age.	Number and Source of Culture.	Type.
A. R.....	2¼ mos.	No. 1, Sputum; No. 45, Feces.	Human.
J. C.....	1⅓ yrs.	No. 16, Mesenteric nodes; 19, Spleen; 20, Bronchial node.	"
J. C.....	5 mos.	No. 58A, Sputum; 58B, Cerebrospinal fluid.	"
M. B.....	3½ "	No. 62, Mesenteric node.	Bovine.
E. H.....	1¼ yrs.	No. 63,* Lung; No. 69, Mesenteric node.	"
M. I.....	2⅔ "	No. 66, Bronchial nodes.	"
W. G.....	7½ mos.	No. 71, Bronchial nodes.	Human.
M. McD.....	6 "	No. 97, Liver; No. 98, Lung; No. 99, Spleen	"
	6 "	No. 100, Mesenteric nodes.	"
F. A.....	3⅚ yrs.	No. 122, Mesenteric nodes; No. 123,* Lung.	Bovine.
J. Van H.....	1½ "	No. 148, Cerebrospinal fluid.	Human.
I. B.....	5½ "	No. 164, Lung; No. 165, Bronchial nodes.	"

Total cases..... 11 { Bovine type..... 4; Human type..... 7 }

* Not finished in rabbits, but culturally bovine type.

TUBERCULAR MENINGITIS, INFANTS.

Name.	Age.	Number and Source of Culture.	Type.
M. L.....	5 mos.	No. 2, Sputum; No. 4, Cerebrospinal fluid.	Human.
M. S.....	10 "	No. 61, Cerebrospinal fluid.	"

Total cases..... 2 { Bovine type..... 0
Human type..... 2 }

Note: For other cultures from cerebrospinal fluid see under generalized tuberculosis.

Dr. Adami relinquished the chair to Dr. William H. Welch, of Baltimore, who presided during the remainder of the Joint Session.

STUDIES IN ATYPICAL FORMS OF TUBERCLE BACILLI ISOLATED DIRECTLY FROM THE HUMAN TISSUES IN CASES OF PRIMARY CERVICAL ADENITIS.

SPECIAL REFERENCE TO THE THEOBALD SMITH GLYCERIN-BOUILLON REACTION.

By Charles W. Duval, M.D.,

Professor of Pathology, Tulane University, New Orleans.
(From the Pathological Laboratory of the Montreal General Hospital.)

Introduction.

Koch's statement in 1901[1] that bovine tubercle bacilli are quite incapable of infecting human beings has led to much careful research being devoted to the identification of the type of tubercle bacilli which can be derived from tuberculous lesions in man. As one of the criteria of type, the glycerin-bouillon test introduced by Theobald Smith[2] in 1905 has been used to separate the human from the bovine type. It has now been established that the bovine bacilli can be implanted upon and grown in human tissues, where they produce lesions of tuberculosis. My own studies have been devoted to the identification of the types of tubercle bacilli derived from cultures from a small series of cases of primary cervical adenitis. The clinical course of the disease in the several instances was quite similar, while the tubercle bacilli isolated and studied carefully over a period of two years have proved to be distinct from one another. On the other hand, the clinical appearances observed in these cases were quite different from those usually observed in tuberculous cervical adenitis, and led directly to my undertaking a study of the bacilli yielded by the lesions.

The four cultures which form the basis of this communication were studied with the view of determining, if possible: (1) the type of infection; (2) whether the growth features, reaction changes in glycerin bouillon, and virulence for rabbits and guinea-pigs remain relatively constant for a period extending over years; (3) if transitory changes occur in virulence, growth, and reaction in bouillon, which might explain the so-called "intermediate" types of bovine and human cultures which have been described; (4) whether the

T. Smith glycerin-bouillon test serves to determine degrees of adaptation in man to bacilli of the lower host-species.

A pure culture was obtained in each case by transplanting portions of the infected tissues from the neck to a modified egg medium compounded and prepared as follows: The yolks are carefully separated from the whites of twelve eggs and each dropped separately and aseptically into a flask containing 100 c.c. of human blood serum, 200 c.c. of distilled water, and 10 c.c. of glycerin which has already been sterilized by the intermittent method of sterilization (Arnold). The flask is now thoroughly shaken and the mixture carefully tubed. These tubes are heated in the slanted position at a temperature not exceeding 70° C. until the consistence of the medium is sufficiently firm to insure its holding together when the tubes are in the upright posture. It is essential to obtain the egg mixture sterile in the test-tubes before they are inspissated, so that the one heating, which is necessary to solidify the medium, suffices. This gives a soft, golden-yellow medium, with plenty of water of condensation. The cotton plugs are paraffined to keep the medium moist.

The inoculated egg medium presented within five to seven days visible growth in the form of discrete colonies over and about the implanted material, resulting within two weeks in the development of large, elevated, tubercular masses.

From the original cultures, a growth upon glycerin bouillon was initiated by depositing upon sterile paper "floats" masses of egg culture. Further, guinea-pigs were inoculated subcutaneously with tuberculous material from the neck. After the tuberculous process was set up, portions of the caseous glands were planted upon the modified egg medium. The growth thus obtained was transferred to glycerin bouillon by the method described above. The results of variation in biochemical reactions referable possibly to the difference in mode of isolation will be commented upon later.

After the initial isolation, observations upon growth features, reaction changes in glycerin bouillon, and virulence for rabbits and guinea-pigs were observed as to their relative constancy over an extended period.

The glycerin-bouillon tests were carried out with the following technic: Three to six siphon-flasks were simultaneously inoculated from the same culture and controlled by similar transplants of human, bovine, and avian standard cultures of the same age and grown upon the same medium.

Titrations were begun from the new cultures and the controls as soon as peripheral growth appeared about the floating transplants. It should be noted that before inoculation all the bouillon, which was prepared in the usual way from fresh muscle infusion, was accurately standardized and the percentage of acidity of each carefully tabulated. Throughout the experiments 500 c.c. flasks were employed in order to provide for the waste by

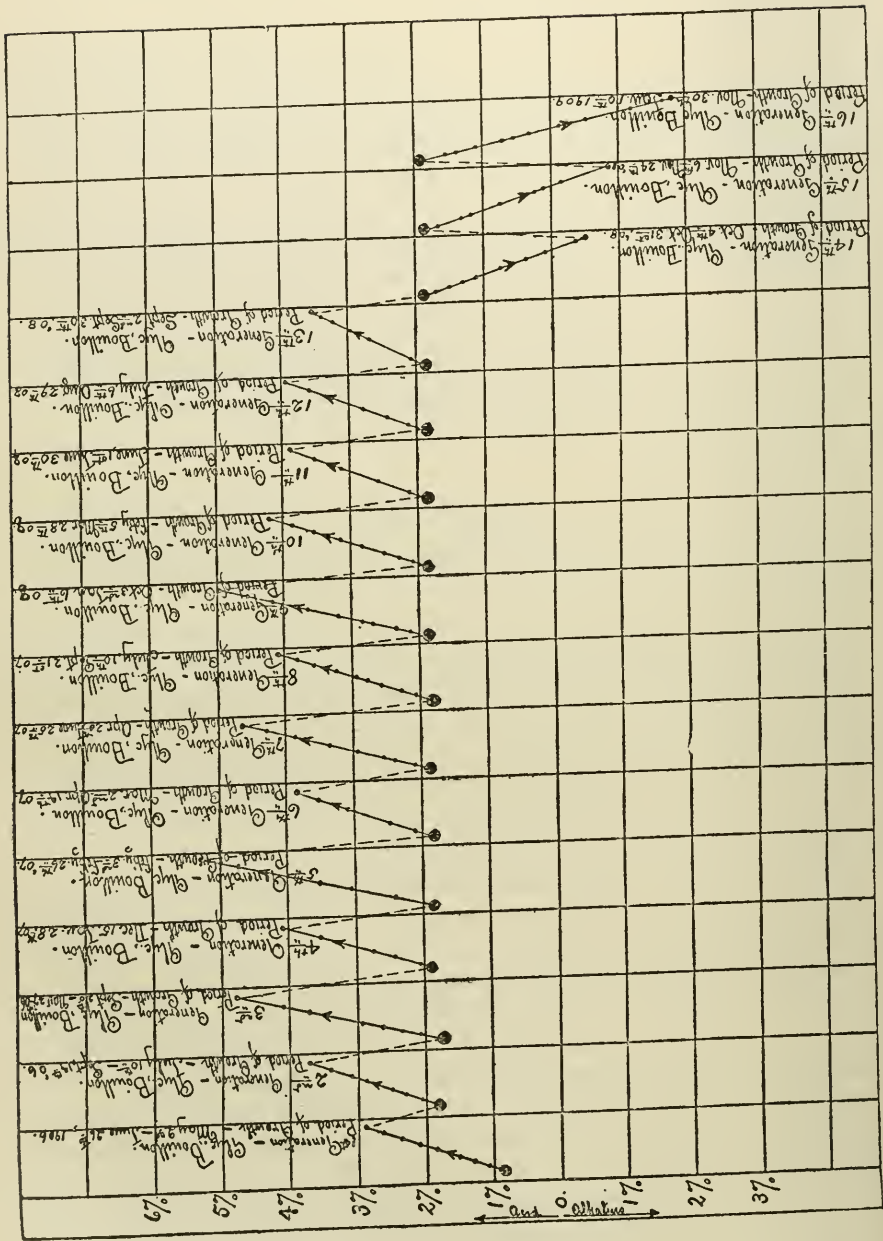

Chart I.—Showing the reaction upon glycerin broth of Culture I over continuous period of thirty months. Dots upon arrowed lines indicate titration intervals. Note the complete change in reaction for the fourteenth generation.

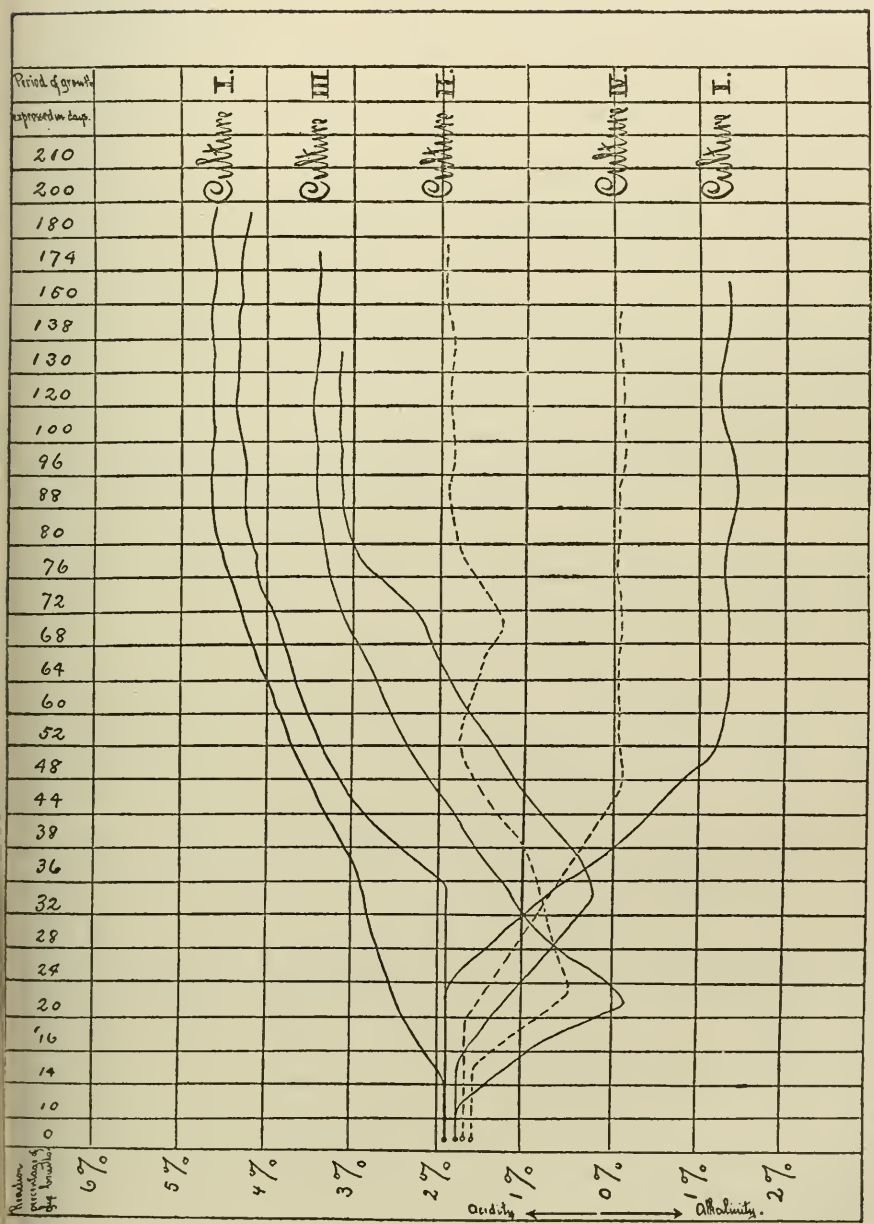

Chart II.—Illustrates the glycerin bouillon curves. Unbroken lines represent "atypical reaction" curves.

titration and loss by evaporation and to make possible an accurate comparison of the inhibitive influence of the growth products of the different cultures. Titrations were repeated at intervals of one to two weeks over a period of six to twelve months. The quantity for all titration tests was 5 c.c. of the bouillon culture-medium in 45 c.c. of distilled water. The initial acidity of the glycerin bouillon was varied, and a series of 1, 1.5, 2, 2.5, and 3 per cent. acidity was observed.

Finally, as a collateral study, various modifications of the ordinary bouillon preparation were employed with the view of determining whether growth or reaction was altered; for instance, additions of small quantities of ox-bile and glycogen to the bouillon, and the employment of special infusions from beef, chicken, and human muscle, with and without the addition of glycerin and peptone, were used, but without demonstrable effect upon growth or biochemical reactions. The same may be said of glycerin-bouillon cultures matured under partial anaërobic conditions.

The virulence of the new cultures with relation to growth variations was determined from time to time and compared with the virulence of the standard type cultures by subcutaneous and intravenous inoculations of rabbits and guinea-pigs. The dosage was standardized as far as possible by weighing and emulsifying in physiological salt solution equal quantities of growth material from the various cultures.

The Clinical Cases.

In all the cases the tuberculous process manifested itself as a rapidly increasing swelling of the neck, which in every way simulated an acute pyogenic infection. It was necessary in two of the patients to perform a tracheotomy to relieve the respiratory distress. A careful physical examination failed to show any signs elsewhere in the body of tuberculosis.

Three of the cases died of acute disseminated miliary tuberculosis in a few weeks after the first symptoms of cervical enlargement were noted. The fourth case was treated with tuberculin and apparently made a complete recovery. It was remarkable with what rapidity the tuberculous swelling disappeared after the administration of T. R. tuberculin, though the culture isolated was proved to be of the bovine type, except for its want of virulence for rabbits.

The three autopsies showed a primary tubercular focus in the cervical lymph-glands from which resulted acute general miliary tuberculosis. In none of these cases was there a mixed infection.

The following are brief clinical notes and abstracts from the autopsy protocols:

Case I. *Clinical History.*—Mrs. L., forty-nine years old, a native of Canada, who lived on a farm all her life, entered the Montreal General Hos-

pital June 4, 1906. Three weeks before admission she noticed for the first time a swelling on the left side of the neck, which rapidly increased in size during the next five days, when it ruptured and discharged. In two weeks the swelling had spread over the entire left side of the neck from the lower jaw to the clavicle. At no time did the mass cause pain or give rise to tenderness on pressure.

On admission to the hospital there was a large fluctuating mass, approximately the size of the closed fist, on the left side of the neck, extending from the anterior border of the trapezius muscle forward to the median line. The skin over the tumor was tense, shiny, and adherent. Below the angle of the jaw there was an open wound leading into a large cavity. The carotid vessels and parts of the brachial plexus were denuded and the left parotid gland was involved in the mass. The tonsils and lymphatic glands on the right side of the neck, as well as the superficial nodes over the rest of the body, were not enlarged. The patient has neither cough nor expectoration. Following incision a stained smear preparation of the pus was crowded with acid-fast bacilli. The bacilli occurred for the most part in closely aggregated masses, and in order to obtain them sufficiently scattered for a microscopical study it was necessary to dilute one part of the pus in three parts of water. The thinner parts of the expressed material contained myriads of pinhead and smaller sized reddish-brown granules, which, when crushed and stained, proved to be pure masses of the bacilli.

A small quantity of the pus was transplanted upon modified egg medium and also upon the ordinary culture-media and incubated at 37° C. The egg mixture after four or five days became thickly studded with discrete colonies, 1 mm. in size, which proved to be acid-fast bacilli. All the inoculated tubes of ordinary media remained sterile—a fact especially significant in view of the necrotic condition of the tissues and the presence of an open avenue for secondary infection.

Full-grown guinea-pigs and rabbits were inoculated subcutaneously and intraperitoneally with 0.5 c.c. each of the pus from the neck. The guinea-pig and rabbit that received intraperitoneal injections died within fifteen days of generalized tuberculosis. There was no intercurrent infection in either animal. Both animals, in addition to the miliary tubercles which studded the various organs, showed a pleuritis and pericarditis with effusion. The rabbit inoculated subcutaneously died on the twenty-sixth day. The autopsy revealed an advanced tuberculosis, the lungs, liver, and spleen showing the most extensive involvement. The guinea-pig similarly inoculated died on the fourteenth day of disseminated tuberculosis. Pure cultures of tubercle bacilli were recovered directly upon modified egg medium from the spleen of each animal.

From the date of admission the patient failed rapidly, and died five days later from acute general miliary tuberculosis; or four weeks after the first appearance of the disease.

Autopsy.—Sixteen hours post mortem. Body of a well-nourished woman. The whole left side of the neck is occupied by a large nodular mass which extends from the lower jaw to the clavicle and from the trapezius muscle to the median line in front. Over the tumor are three linear incisions; the largest measures 6 cm. in length and opens into a cavity which is roughly the size of an orange. The edges of the incisions are gaping, the surrounding

tissues are friable and of a purplish-black color. Traversing the largest cavity are the exposed sternocleidomastoid muscle and the trunks of the brachial plexus. This cavity communicates with smaller ones in the left submaxillary, sublingual, and parotid regions.

The peritoneum and pleuræ are beset with disseminated miliary tubercles.

The lungs are crepitant throughout, and everywhere beset with innumerable discrete tubercles. No evidence of old tuberculous foci.

The other organs, aside from acute miliary tubercles, show nothing remarkable.

A pure culture of B. tuberculosis was isolated from the heart's blood on egg medium, twelve or more colonies developing from six platinum loopfuls of the blood.

Anatomical Diagnosis.—Primary tuberculosis of the right cervical lymph-glands; acute general miliary tuberculosis; B. tuberculosis septicemia.

The tuberculosis in this case was undoubtedly primary in the cervical glands, for a most careful search at autopsy failed to reveal any older focus.

In the human tissue the tubercle bacilli were quite long and slender and transversely segmented. They retained Gram's stain readily. Indeed, even in tissue-sections fixed in Zenker's fluid, embedded in paraffin, and treated in the usual routine manner with eosin-methylene-blue, the bacilli were stained intensely with eosin. This I have not seen before; and so unusual is it for them to stain in tissues without the employment of special methods, I was inclined at first to doubt their authenticity.

The bacilli were so numerous in the sections of the human spleen and lymph-nodes that it was difficult to discern clearly the nuclei of the tissue-cells even in fields where there was no necrosis. The organisms occurred without definite arrangement. Frequently the bacilli were packed so closely together that whole fields of the microscope consisted of one dense layer of slender, beaded rods. In those parts of the sections where the bacilli were less dense, large numbers of them appeared within mononuclear leukocytes. These engorged cells were analogous to the phagocytes for red blood-cells, so common in the lymphoid structures in typhoid fever. One could frequently count fifty or more bacilli within a single cell. The descriptions of occurrence of enormous numbers of leprosy bacilli in human tissues are inadequate to convey a correct idea of the picture here presented in tuberculosis. Lydia Rabinowitsch,[3] however, describes a similar distribution of bacilli and phagocytic cells in tuberculous tissues of fowls.

The bacilli when cultivated on artificial media presented an entire change in morphology from that observed in the tissues; instead of the long, slender, beaded rods, appeared small plump bacilli almost coccal in character, and without a suggestion of transverse massing of the chromatin. On egg-medium the first generation presented a most curious arrangement of the

bacilli, which even the manipulations with the platinum loop failed to disturb. The individual rods occurred one behind the other in parallel rows, forming broad, wavy bands that extended across many fields of the microscope. This end-to-end arrangement of the individual organisms is most unusual in tubercle bacilli and resembles the appearance met with in anthrax colonies.

The character of the growth on ordinary media employed for the cultivation of tubercle bacilli completely corresponds with the human type of culture. The growth was always very dry. Though sometimes fine and film-like, the culture at other times was luxuriant, lumpy, and of wax-like whiteness. It never presented the "moist appearance" that is said to be characteristic of avian cultures. A feature of the bacillus was its prolonged viability on artificial media; a profuse growth having been obtained from the original culture, which had been sealed and kept corked at room temperature for more than two years. Lydia Rabinowitsch[3] claims that prolonged viability is a distinguishing feature of the avian bacillus; in some instances under refrigeration the culture remaining alive for two years. Culture I not only remained viable for a period of years at ordinary temperature, but retained its virulence for rabbits and guinea-pigs.

The results of animal inoculation with culture I afforded a complete illustration of the possible variation in the histological lesion. There was a distinct difference in the microscopical character of the human lesion and that produced experimentally. The subacute inflammatory type of lesion in man, which also occurred in the earlier experimental animals, was a striking feature, and would indicate an extremely high degree of virulence. The lesion in man consisted chiefly of lymphoid and plasma cells and large numbers of polymorphonuclear leukocytes, with only an occasional epithelioid type of cell and no giant-cells. In the experimental lesion produced by the culture somewhat attenuated in virulence the epithelioid elements with central necrosis and giant-cells predominated. Giant-cells did not occur in the earlier rabbits and guinea-pigs inoculated, nor in the lesions of the chickens. In later experiments, however, the animal tissues showed numbers of giant-cells associated with the lesions. It would seem that the occurrence of giant-cells in tuberculosis, as in glanders,[4] depends more on the virulence of the organism than on any other factor. This culture at least suggests that the type of lesions, whether exudative or proliferative, is due to the number and virulence of the bacilli.

Lydia Rabinowitsch[3] noted in avian tuberculosis distinctive differences in the histological picture. In the fowl the alveoli of the lungs were filled with an exudate composed of epithelioid and lymphoid cells, together with numerous giant-cells containing large numbers of the tubercle bacilli. This author attaches special significance to these large cells filled with an enormous

number of bacilli, and regards them as characteristic of avian tuberculosis. This same histological picture is seen in the human and experimental lesions produced by culture I. Here the lymphoid and large mononuclear cells were crowded with bacilli and presented an analogous picture in this respect to leprosy.

The culture, after it had become attenuated in virulence, produced, after repeated intravenous injection, a lesion in the glands of the rabbit which exhibited a certain histological resemblance to that of Hodgkin's disease, such as Dorothy Reed,[5] Longcope,[6] and others have described. The microscopical section of the glands showed an extensive hyperplasia of the lymphoid tissue, with large numbers of the lymphoid cells in mitosis. At the center of the lymphoid follicles there were well-defined collections of endothelial cells, and in the lymphoid tissues were great numbers of similar cells, which in places occluded the sinuses. Plasma cells were markedly increased throughout the gland. The polymorphonuclear leukocytes and eosinophiles (amphophiles) were especially numerous. What appeared to be epithelioid cells, together with large numbers of giant-cells, completely obscured the normal structure of the gland.

The virulence of the culture was tested for rabbits and guinea-pigs, the animals being approximately of the same age and weight. Chickens, pigeons, and rats were also used. Each comparative test was made intravenously, intraperitoneally, and subcutaneously with rabbits, guinea-pigs, and pullets. In order to insure a uniform dosage a weighed portion of surface growth from bouillon was thoroughly emulsified in salt solution and subsequently injected. One milligram of culture given intraperitoneally produced a fatal tuberculosis in these animals in four to six weeks. The same dose administered subcutaneously required a much longer time to produce the same result, and in some instances both guinea-pigs and rabbits lived for months. Ten milligrams, however, when injected subcutaneously, gave rise to disseminated tuberculosis in six to ten weeks.

A series of six chickens, three hens and three pullets, received each 1 mgm. of the culture intraperitoneally, subcutaneously, and intravenously. Six weeks later the fowls were killed and the two pullets which had received intraperitoneal and intravenous injections showed well-marked lesions of tuberculosis. The mesentery of the intraperitoneally injected pullet presented numerous discrete, 2 mm. sized tubercles. No lesions in the other organs were noted. The pullet which received an intravenous injection showed a number of small tubercular nodules in the lungs and spleen. The subcutaneously inoculated pullet and the three hens presented no trace of tuberculosis. When we consider the small dosage and the short period allotted the chickens to live, the occurrence of macroscopical lesions is most remarkable. Larger doses invariably produced

lesions in the half-grown chickens, which, as Bang claims, are far more susceptible than full-grown fowls. Positive results occurred in chickens following intraperitoneal inoculation with greater frequency than for any other method of introduction. As controls, fowls were injected with bovine IX and human XII (Theobald Smith) with negative results. These tests with the smaller laboratory animals and with fowls are far too few to permit of final conclusions; still it would seem that the culture is possibly avian in type.

The reaction curve for this culture in glycerin bouillon was decidedly atypical for more than two years. It always gave an increase in the percentage of acidity, without the initial fall that is so characteristic of all tubercle cultures. The reaction was occasionally delayed for weeks after the growth had completely covered the bouillon surface (a feature in my experience not peculiar to any strain), but when the change in reaction began, there always occurred a constant rise, until an elevation of five or more points higher than the initial acidity was attained, after which there was no further change.

For a period of more than two years after the culture was recovered from the human tissue the behavior toward glycerin broth was certainly unlike any known human or bovine type of organism, since invariably it failed to produce the "initial fall" in the acidity percentage. Again, during this period the culture did not behave in respect to glycerin bouillon as the control avian culture (Smith), which, as O. Bang[8] first pointed out, describes the same reaction curve as the bovine, namely, a gradual decline in percentage acidity until an alkaline reaction results. Quite recently, however, this culture has given a complete change in the reaction curve.

It has been my practice each month since the isolation of the culture to make fresh transplants upon glycerinated bouillon to determine whether subsequent generations might not show a variation in reaction. I was therefore surprised to discover after two and one-half years that the culture suddenly underwent a complete reversal in its action upon glycerin, producing now the typical curve of the avian bacilli.

The organism from this case (culture I) was regarded at first as a modified avian bacillus or an "intermediate" between the avian and human types. Its prolonged viability under artificial conditions and the production of tuberculosis in the fowl are points indicating an avian histogenesis, but the former high acid production and the absence of moist growth on media do not correspond to the typical avian bacillus. However, the recent behavior upon glycerin bouillon leaves little doubt that it is avian in type.

Case II. *Clinical History.*—Samuel B., twenty years old, a native of Ireland, entered the Montreal General Hospital in October, 1906, complaining of shortness of breath and great weakness. Two weeks before admission

he had noticed for the first time a swelling on the right side of the neck, which rapidly increased until it attained approximately the size of an orange.

The patient was poorly nourished and had a temperature of 104° F. There was a large, movable, insensitive mass situated above the right clavicle, extending upward as far as the level of the hyoid bone and downward behind the clavicle, where it became continuous with an area of mediastinal dullness. Subsequently the temperature ran a septic course. Diarrhea became persistent. This swelling was opened under surgical precautions and a large amount of creamy yellow material removed. A portion of this was immediately spread over modified egg-medium, which after three weeks at 37° C. developed a pure culture of the tubercle bacillus. The ordinary culture-media inoculated at the same time remained sterile. Stained smear preparations of the pus from the neck showed only a moderate number of short, thin, acid-fast bacilli. The first growth on artificial media was not luxuriant and rather slow in development, but there was no difficulty in getting transplanted "floats" from the original culture to grow on glycerin bouillon. Pus was injected intraperitoneally and subcutaneously into rabbits and guinea-pigs. The rabbits which received an intraperitoneal inoculation died six weeks later of generalized tuberculosis, while the one which had been injected subcutaneously, when killed four months afterward, showed only tuberculosis about the site of inoculation and small nodules in the lungs. Both guinea-pigs died of tuberculosis—the intraperitoneal animal in five weeks and the subcutaneous one in nine weeks. Though the period of life is longer for this series of animals than those of Case I, the apparent difference in degree of virulence of the two cultures could well be due to the great disparity in the number of bacilli injected.

Autopsy.—Fifteen hours after death. Subject emaciated. On the right side of the neck there is a swelling that extends from the jaw downward and behind the clavicle. Over this area is an incision 3 cm. in length, which exposes a large mass of yellowish-white, necrotic material. On opening the mass it is found to be continuous with another in the anterior mediastinum, which is approximately 12 cm. by 16 cm. in extent and completely encircles the trachea. Both the anterior mediastinum and neck tumors are composed of what appears to be greatly enlarged caseous glands which have fused into one elongated mass. The other superficial lymphatic glands of the body are not enlarged.

The right pleural cavity contains 500 c.c. and the left 200 c.c. of clear serous fluid. The posterior surface of the right lower lobe is covered with fibrinous exudate. On section this lobe is studded with areas 2 to 4 mm. in diameter. The other organs contain tubercles.

Anatomical Diagnosis.—Glandular tuberculosis; acute miliary tuberculosis of the liver, spleen, and kidneys; acute tuberculous pleuritis.

The organism recovered from this case—designated culture II—belongs undoubtedly to the human group of tubercle bacilli. Though the growth was always slow to develop on glycerin bouillon, the culture corresponds in other features, especially virulence for rabbits, to the human variety; and, further, while the biochemical reaction, as interpreted by glycerin-bouillon titrations, showed at times aberrations from the normal, the curve furnished by this organism was found, on the whole, to tally closely with the human type.

CASE III. *Clinical History.*—Francesco B., twenty-four years old, entered the Montreal General Hospital in October, 1906, complaining of a swollen neck and difficulty in breathing and swallowing. Personal history negative. Both sides of the neck were enormously swollen, but not painful or tender. There were fluctuating masses on both sides of the neck, extending from the mastoid processes to the clavicles. They were so large that the patient breathed and swallowed with great difficulty.

The day after admission to the hopsital the patient had three very severe attacks of dyspnea. At these times he became markedly cyanotic and tracheotomy was necessary to save life. The third day after admission the mass on the right side of the neck was incised and 16 ounces of thick creamy pus and caseous material removed. The mass on the left side was opened on the following day and 8 ounces of pus evacuated. A portion of the pus was transferred to egg-medium, which showed a pure growth of tubercle bacilli after ten days' incubation.

A pair of guinea-pigs and rabbits were inoculated subcutaneously and intraperitoneally with a portion of an emulsion prepared from the discharge. The rabbits were killed, one four weeks, the other three months, after inoculation. The intraperitoneally injected animal showed no trace of tuberculosis, while the one which was subcutaneously injected contained definite tuberculous lesions at the site of injection and in the glands of the groin. The guinea-pigs injected had increased in weight. The superficial inguinal glands of the subcutaneously inoculated animal were enlarged and contained infarcts and caseous nodules. In the intraperitoneally inoculated pig the only tubercular lesion presented itself in the omentum. The cultures recovered from these animals in no way differed from the one obtained directly upon artificial medium from the human tissues.

The patient after operation rapidly lost weight and developed fever. At no time was there any sign of pulmonary disease. The patient died on October 31st of sudden cardiac failure, five weeks after the first symptoms were noted.

Autopsy.—Thirteen hours post mortem. Body of a fairly well-developed and emaciated Italian man. On either side of the neck, which is enormously swollen, there is a deep incision, 3 cm. in length, the edges of which are gangrenous.

Peritoneal Cavity.—The omentum and intestines are glued together by recent fibrinous adhesions. The parietal peritoneum is studded with glistening tubercles. The mesenteric lymph-nodes are enlarged and caseous.

The lungs, spleen, liver, kidneys, and brain are thickly studded with minute pin-point, translucent tubercles. No old lesion in the lungs.

Cecum, descending part of the colon, and the lower part of the ileum contain numerous tuberculous ulcers.

Anatomical Diagnosis.—Primary tuberculosis of the cervical glands; acute general miliary tuberculosis; acute ulcerative enterocolitis.

A comparative study of the culture isolated from this case—designated culture III (atypical)—corresponds with the human variety of tubercle, except in regard to its behavior at times upon glycerin broth, where it yields a neutral or 0.5 per cent. alkaline reaction before the rise in acidity is established.

The culture possesses a low degree of virulence for guinea-pigs and rabbits. Full-grown rabbits seldom developed tuberculosis following intraperitoneal injections of 10 mgm. of fresh culture. Adult guinea-pigs inoculated intraperitoneally with the same amount frequently increased in weight, and when killed three months afterward showed only a few nodules in the omentum.

Case IV. *Clinical History.*—Antonio C., aged sixteen, entered the Montreal General Hospital in March, 1908, complaining of a swollen neck. On admission the patient is a well-developed and nourished Italian boy. The cervical glands are enormously enlarged on both sides of the neck, and range in size from a marble to that of a hen's egg. They are discrete, freely movable, and give no tenderness on pressure. The mediastinal glands on percussion are found greatly enlarged and apparently continuous with the cervical mass. The axillary, inguinal, and other superficial glands of the body are not enlarged, but the abdominal glands can be distinctly palpated. The heart and lungs are normal. One week after entrance to the wards the swelling of the neck greatly increased in size and became less nodular in character; instead of freely movable, discrete masses, there is now a solid tumor which extends from the jaw downward under the clavicles and into the mediastinum. The swelling was opened under aseptic precautions, and a gland 2 by 1 cm. in diameter removed for bacteriological study. On section, it was firm and contained large, yellowish-white areas; no bacilli, however, were demonstrable in the stained smears. Cultures were obtained directly upon egg-medium from transplanted pieces which were excised from the central part of the gland. The ordinary laboratory media inoculated remained sterile. The egg-medium showed the first sign of growth after three weeks, when it became studded with small colonies of the tubercle bacillus.

Soon after admission the patient was given at regular intervals in gradually increasing doses TR. (tuberculin), under which treatment the cervical enlargement completely subsided. The glandular mass in the neck began to diminish in size from the first dose. Those in the mediastinum and the abdomen also disappeared. The patient gained markedly in weight, and the temperature fell to and remained normal. He was discharged apparently well one month after the first administration of the tuberculin.

The culture from this case, designated IV, completely corresponds in respect to growth and reaction upon glycerin bouillon to the standard bovine type; however, it does not correspond in degree of virulence for rabbits. Fifty milligrams of fresh culture emulsified in 5 c.c. of sterile salt solution and injected intravenously into the ear of the rabbit failed repeatedly to produce lesions. Rabbits inoculated subcutaneously with the same dosage did not develop disseminated tuberculosis; and when killed months afterward, presented lesions only at the site of inoculation or in the regional lymph-glands. On the other hand, guinea-pigs injected intraperitoneally with 10 mgm. of the culture rapidly developed generalized tuberculosis. As

yet I have not tested the virulence of the culture for calves. In respect to growth, the culture always manifested a tendency to develop slowly. Though under artificial cultivation for nearly a year, it still refuses to grow on glycerin-agar. On glycerinated bouillon growth increases very slowly, though always as a colony-mass, and at no time film-like, which is so often the case in feebly growing bovine cultures. For the present, at least, I regard culture IV as an atypical bovine variety of the tubercle bacillus possessing a low degree of virulence for rabbits. Atypical cultures producing a neutral or slightly alkaline reaction upon glycerin broth have been described by Theobald Smith[9] and O. Bang,[8] and regarded by them as "atypical" human rather than bovine in type; however, the slow multiplication of culture IV on the more favorable media and the inability to grow at all on glycerin-agar, together with the fact that it produces a neutral or slightly alkaline reaction, are factors strongly in favor of a bovine nature.

The Glycerin-bouillon Reaction as a Differential Test.

Theobald Smith[10] in 1905 described the difference in behavior of "bovine" and "human" bacilli toward glycerin bouillon which corresponded with the author's previously recognized variation in virulence. Before the glycerin-broth test was known, however, the differentiation of these depended mainly on virulence and rapidity of growth. The feeble and slowly growing organism, if highly virulent for rabbits when injected intravenously, was regarded as bovine in type; while the luxuriant and rapidly growing culture that possessed a low degree of virulence for rabbits was classed as the human variety.

In my experience the glycerin-bouillon test is more reliable than "degree of virulence" in the differentiation of mammalian strains, provided it is repeated over a long period of time. Even with regard to avian cultures O. Bang[8] claims that the alkalinity produced in glycerin broth is so much greater than the bovine type that it serves to distinguish between them. My observations upon the behavior of culture I are in accord with this finding.

The test, which consists of growing the organism on the surface of glycerin bouillon and titrating from time to time to note the change in reaction, not only divides the tubercle family into two distinct groups, but it may be a qualitative means of detecting bacilli of the modified bovine type in the human body or the degree of adaptation. Though the method does not sharply differentiate between bacilli of the lower host species, it is of aid in the identification of these lower type forms in the human body. Differences in virulence and character of growth are too variable to allow us to admit unreservedly that one type may become transformed into another through animal passage. These properties, even with the same culture,

vary within wide limits, more especially in the growth features, which depend so largely on the nature of the culture-medium. Yet it would seem that these modifications in biological and pathogenic characters have been the crucial tests employed by those who claim to have transformed the avian into the bovine type of bacillus.

L. Rabinowitsch,[3] in a study of 95 avian cultures, noted a whole growth scale from the typical, moist, shiny growth of the avian to the dry, scaly appearance of the mammalian type of bacillus, and is most emphatic that from three birds she isolated cultures that were identical with the human type of the bacillus. She also claims to have completely transformed a typical avian culture into the human type of bacillus by repeated passage through animals. In view of the fact that she draws particular attention to the inconstant and interchangeable differences in growth and virulence of the mammalian and avian bacilli, and that in morphology and staining reaction there is no essential variation, it is hard to understand how "atypical" forms were definitely determined, especially as there is no mention of the glycerin-bouillon reaction. If we regard the tubercle bacilli of the different host species as variations of the same family, the existence of "intermediate forms" is not only possible, but highly probable. There is reason to believe that aberrant types of the tubercle bacillus exist as they do for other bacterial species, but there is as yet no absolute test by which the finer differences may be determined. Our present methods at best are too inadequate to permit us to state positively with regard to "intermediate" forms of the tubercle bacillus. Some so-called atypical cultures that have at first behaved unlike the standard types, if repeatedly tested over a longer period of time, might eventually fall into the well-known groups. The most striking examples of this change have occurred with cultures I and III of this series.

It would seem that these strains have only recently accepted a new environment and are but slightly altered by the host influence. In this way it is possible to explain their odd behavior upon glycerin broth after a year's sojourn outside the animal body. For more than a year culture III, though constantly under cultivation and repeatedly tested, always approached, but never reached, the neutral point when grown in glycerin bouillon, nor was there any rise in acidity though the flasks were kept for months. Subsequent tests, however, have shown the fall in reaction to the neutral point to be followed by a rise in acidity. On two occasions the reaction fell slightly below the neutral point, and later arose in acidity higher than the original percentage (see Table I). This latent action on glycerin occurred not only for the culture recovered directly from the human tissue, but also for the one recovered through guinea-pigs. The question of a mixed tubercle infection is possible, but hardly probable, in this case.

The glycerin-broth test at first indicated that the culture was a "modified" bovine, but its subsequent behavior in this medium, together with other biological peculiarities, makes me regard it as an aberrant human type.

Culture I is the most significant example of the necessity for continued observation over a long period of time. For more than two years it always gave an atypical reaction curve in glycerin bouillon. The medium steadily increased in percentage acidity without fluctuation until it reached four or five points above the initial per cent., where it remained stationary. Recently, however, the culture has shown a complete change in its behavior upon glycerin broth; instead of the rise in percentage acidity, there now occurs a gradual uninterrupted fall to 0.5 to 1.0 per cent. alkalinity, from which there is no further change. This reversal of the metabolic activity of this culture under artificial cultivation is extremely interesting, and would argue–(1) a mixed infection in which the least saprophytic type at first predominated and subsequently the more saprophytic variety predominated, or (2) the culture was originally an avian whose vital function had been altered during its sojourn in the animal body, but not sufficiently to establish it permanently.

These "atypical" cultures in glycerin bouillon show, on the whole, a variation in reaction from the standard types analogous to the variation of the pneumococcus in inulin, which difference in degree of acidity corresponds with differences in growth and virulence.

Explanation of the Glycerin-bouillon Reaction.—To determine the effect of growth upon the glycerin-bouillon reaction the following experiments were carried out: A series of glycerin-bouillon cultures* of bovine, human, and avian bacilli were grown for a stated period at 37° C. All the flasks were then titrated and the reactions carefully noted. Next, one-half of these cultures (a complete series) was retained at room temperature for a further period, and observations upon the reactions carried out at intervals of five and ten days. Finally, the remaining half of the cultures after titration (also a complete series) was transferred from incubator to ice-chest temperature and the reaction noted from time to time under the latter conditions. Observations extended for some series over a period of six months, others three months, and in none was it less than eight weeks. Flasks holding 500 c.c. were employed in the tests in order to contain a sufficient amount of bouillon to permit of repeated removal for titration purposes. In these tests the amount of surface growth and the reaction of the bouillon were purposely varied. The surface growth was shaken to the bottom of the flasks upon removal from the incubator. Under these conditions it was interesting to note that the human type of tubercle showed not the slightest

*Bovine IX and VIII, human XII, and avian II, which were kindly supplied me by Prof. Theobald Smith; and cultures I, II, III, and IV of my own series.

difference in the final reaction from cultures kept undisturbed at 37° C. In flasks containing the human strains where the reaction was beginning to fall toward neutral point at the time of removal from the incubator the acidity did not continue to lower, but eventually rose to a point equal to or higher than the initial acidity (see Table I). It made not the slightest difference in the final reaction whether the growth had been shaken down from the surface of the bouillon or not. Flasks containing the bovine and avian types showed no further change in either direction after they were removed from the incubator. Certainly in the case of the cultures kept at ice-chest temperature there was every reason to believe that the growth had ceased, yet the development of the complete reaction proves that continued growth with the human strain cannot possibly explain the rise in acidity of the glycerin bouillon.

The result of this test does not support the view that the difference in reaction for human and bovine mammalian types of the tubercle family depends on the ability of the living bacilli to split the glycerin molecule with the production of acids, but suggests an autolytic action on the glycerin. Again, avian strains, according to O. Bang,[8] who has tested their action upon glycerin bouillon, produce a neutral or alkaline reaction only when growing on the surface of the medium, which fact also shows that neutralization of the initial acidity is the result of growth activity.

Sometimes with a series of glycerin-bouillon cultures one or more of them may fail to show the slightest change in reaction for months, though the growth is complete and heavy over the whole surface and growing up the sides of the flask. At times a flask whose growth was "complete and down" for more than two months, and so far had not shown the slightest change in reaction, would suddenly begin to rise in per cent. acidity (see Table I).

Occasionally the change in reaction may be so long delayed that the fall to the neutral points occurs before the rise in acidity begins. Again, it is well known that with all types when grown in a broth where no glycerin has been added the reaction drops to neutral or becomes slightly alkaline, and at no time shows a rise in acidity. This trend toward the neutral point must take place in glycerinated bouillon as well; however, with the human type there is, in addition, an action on the glycerin molecule which is distinct, and at times sufficient not only to lower but to cause a rise in the acidity of the glycerin bouillon. Since the number of bacilli undergoing disintegration varies constantly, this factor in itself determines the degree of fluctuation.

That autolysis explains the rise in acidity for the human type of tubercle bacillus when grown in glycerin broth the following experiments show: A series of glycerin-bouillon flasks were first titrated to show distinct variations in reaction, viz., neutral 0.5, 1.0, 2.0, and 3.0 per cent. acidity. To the separate flasks were now added 5 gm. of a bovine, human, and avian culture,

which had been previously grown and removed under sterile precautions from other bouillon flasks. Each flask was now titrated to note whether any change in the reaction had occurred immediately following the addition of the culture, and then placed in the oven at 56° C. for six hours to kill the bacilli. Again after heating the reaction was determined and the flasks placed at ice-chest temperature. Up to this date no change in reaction for any flask had occurred. Four days later the flasks still showed no change from the original reaction. About the eighth day, however, the flasks containing the killed "human" bacilli showed a decided rise in percentage acidity, which from day to day continued to advance, until the final reaction was equivalent to that attained by the living glycerin-bouillon culture under favorable conditions. The flasks containing the killed "bovine" and "avian" bacilli, respectively, failed to show at any time the slightest change in the reaction (see Table II).

The fact that increased acidity occurred in the flasks containing the dead "human" bacilli, and not in the "bovine" or "avian," would indicate that in the autolysis some soluble substance was liberated from the human strain that had a special action upon the glycerin molecule.

The above explanation in the rise in the acidity of glycerin cultures of human tubercle bacilli is, of course, at variance with the statement of the English Commission that this phenomenon was due to the chemical interaction of continued metabolic activity on the part of the human strain.

Virulence.

It is conceded by many that a considerable range in degree of virulence is possessed by the human type of the tubercle bacillus, but T. Smith[12] holds that the most virulent human cultures are not to be compared in virulence with the bovine strains. On the other hand, L. Rabinowitsch[13] states that some human cultures are more virulent for rabbits than the bovine. In this connection it is noteworthy that culture IV of this series, which is a typical bovine type of bacillus according to growth and behavior toward glycerin bouillon, has always manifested a low degree of virulence for rabbits. These animals injected intravenously with 50 mgm. of culture fail to develop fatal tuberculosis.

Culture I when first isolated was equally virulent for rabbits and guinea-pigs and also virulent for chickens. Rabbits succumb approximately within the same period as do guinea-pigs following intravenous injection of 10 mgm. of the culture.

The view held by Arloing[14] and his pupils that bacilli from surgical tuberculosis are less virulent than those of pulmonary disease is not borne out by the study of these cultures, which proves that glandular tuberculosis is not always due to bacilli of reduced virulence or to increased resistance of the host.

TABLE I.—SHOWING THE REACTION OF GLYCERIN BOUILLON FOR CULTURES UNDER DIFFERENT TEMPERATURE CONDITIONS.

Bouillon.	Case.	Culture.	Source.	Virulence.	Inoculation Date.	Titration Dates.		Reaction Per Cent. Acidity.	Remarks.
Beef Inf. 1000 c.c. Peptone 10 grams. Glycerin 40 c.c. Acidity 1.9 per cent.	Mrs. S., age 49, native of Canada. Primary cervical adenitis with fatal tuberculous septicemia.	I (flask "a"). "Atypical" organism with biochemical reactions resembling avian bacilli.	Pus from cervical region. Direct isolation from the human tissue upon modified egg-medium.	Equally virulent for rabbits and guinea-pigs. Chickens are also susceptible.	March 24, 1908.	Apr. 18, '08	Period under Incubator temp.	1.9	Heavy growth covering three-quarters of bouillon surface.
						" 25, "		2.2	Heavy growth covering whole of bouillon surface.
						May 10, "		2.8	Growth completely over surface and up sides of flask.
						" 20, "		3.0	Growth completely over surface and up sides of flask.
						June 1, "		3.2	No change in growth. Flask removed from incubator.
						" 14, "	Period under Room temp.	3.5	Growth at bottom of flask. Bouillon perfectly clear.
						July 4, "		5.0	Growth at bottom of flask. Bouillon perfectly clear.
						Aug. 6, "		5.0	Growth at bottom of flask. Bouillon perfectly clear.
Ditto.	Ditto.	I (flask "b").	Ditto.	Ditto.	March 24, 1908.	Apr. 18, "	Period under Incubator temp.	1.9	Growth heavy; film covering one-half bouillon surface.
						" 25, "		1.9	Growth heavy, film covering three-fourths bouillon surface.
						May 10, "		2.2	Growth over whole bouillon surface.
						" 20, "		2.8	Growth complete and up sides of flask.
						June 1, "		3.0	Growth complete and up sides of flask.
						" 14, "		3.1	Growth allowed to remain on surface of flask.
						July 4, "		4.2	Growth intact over surface of bouillon.
						Aug. 6, "		4.2	Growth intact over surface of bouillon.
Beef Inf. 1000 c.c. Peptone 10 grams. Glycerin 40 c.c. Acidity 2.0 per cent.	Franc. B., age 24, native of Italy. Primary cervical adenitis resulting in fatal acute miliary tuberculosis.	III (flask "a"). "Atypical" unusual reaction in glyc. bouillon.	Pus from cervical region. Direct recovery of culture from the human tissue upon modified egg-medium.	Moderately virulent for rabbits. Highly virulent for guinea-pigs. Avirulent for chickens.	March 13, 1908.	Apr. 18, "	Period under Incubator temp.	2.0	Growth size of half dollar.
						" 30, "		2.0	Growth covers one-half of surface.
						May 10, "		2.0	Growth heavy and complete and up sides.
						" 18, "		2.0	Growth heavy and complete and up sides.
						June 1, "		2.0	Growth heavy and complete and up sides.
						" 14, "		2.3	Growth mostly shaken down.
						July 1, "		0.3	Growth down completely.
						Aug. 5, "		0.3	Growth down completely.

Bouillon.	Case.	Culture.	Source.	Virulence.	Inoculation Date.	Titration Dates.		Reaction Per Cent. Acidity.	Remarks.
Beef Inf. 1000 c.c. Peptone 10 grams. Glycerin 40 c.c. Acidity 2.0 per cent.	Franc. B., age 24, native of Italy. Primary cervical adenitis resulting in fatal acute miliary tuberculosis.	III (flask "b").	Pus from cervical region. Direct recovery of culture from the human tissue upon modified egg-medium.	Moderately virulent for rabbits. Highly virulent for guinea-pigs. Avirulent for chickens.	February 8, 1908.	Feb. 28, '08	Period under Incubator temp.	1.0	Growth heavy and blistered and covers two-thirds of surface.
						March 10, "		Neutral.	Growth complete and up sides of flask.
						" 25, "		Slightly alkaline	Growth complete and up sides of flask.
						April 15, "		0.4	Growth complete and up sides of flask.
						May 1, "	Period under R. t.	1.7	Final change in reaction.
						" 10, "		1.7	Final change in reaction.
						" 20, "		1.6	Final change in reaction.
	Sam. B., age 20, native of Ireland. Primary cervical adenitis resulting in fatal acute miliary tuberculosis.	II (flask "a"). "Human" biochemical reactions completely correspond to the human type of bacilli.	Necrotic material from the cervical glands. Direct isolation of culture from the human tissue upon modified egg-medium.	Low degree virulence for rabbits. Virulent for guinea-pigs. Avirulent for chickens.		April 18, "	Period under Incubator temp.	1.9	Heavy growth covering three-quarters of bouillon surface.
						" 25, "		1.9	Heavy growth covering whole of bouillon surface.
						May 10, "		1.5	Growth over whole surface and up sides of flask.
Ditto.						" 20, "		1.0	Growth over whole surface and up sides of flask.
					March 24, 1908.	June 1, "		0.7	No change in growth. Flask removed from incubator.
						" 14, "	Period under Room temp.	1.4	Growth at bottom of flask. No change in reaction.
						July 4, "		4.4	Growth at bottom of flask. No change in reaction.
						Aug. 6, "		4.4	Growth at bottom of flask. No change in reaction.
						April 18, "	Period under Incubator temp.	2.0	Heavy island of growth size of quarter.
						" 30, "		2.0	Heavy covering on half of surface.
						May 10, "		2.0	Heavy growth covering three-quarters of surface.
						" 18, "		2.0	Heavy complete growth over surface.
Ditto.	Ditto.	II (flask "b").	Ditto	Ditto.	March 13, 1908.	June 1, "		2.0	Growth heavy and thrown into deep folds.
						" 14, "		1.3	Growth heavy and up sides of flask.
						July 1, "		0.9	Growth at bottom of flask for more than a month.
						Aug. 5, "		3.3	Growth at bottom of flask for more than two months.

TABLE I.—SHOWING THE REACTION OF GLYCERIN BOUILLON FOR CULTURES UNDER DIFFERENT TEMPERATURE CONDITIONS.—(*Continued.*).

BOUILLON.	CASE.	CULTURE.	SOURCE.	VIRULENCE.	INOCULATION DATE.	TITRATION DATES.		REACTION PER CENT. ACIDITY.	REMARKS.
Beef Inf. 1000 c.c. Peptone 10 grams. Glycerin 40 c.c. Acidity 2.0 per cent.	Antoine C., age 16, native of Italy. Primary cervical adenitis. Recovery.	IV (flask "a"). "Bovine" growth features and reaction upon glyc. bouillon completely correspond with "bovine bacilli."	Glands of the neck. Direct isolation upon modified egg-medium.	Avirulent for rabbits. Virulent for guinea-pigs. Avirulent for chickens.	August 5, 1908.	Aug 10, '08	Period under Incubator temp.	2.0	Growth size of silver dollar.
						" 14, "		2.0	Growth covers one-half of bouillon surface.
						" 18, "		1.8	Growth completely covers surface.
						" 22, "		1.0	Growth beginning to push up sides of flask.
						" 26, "		0.5	Growth complete and up sides of flask.
						" 31, "		0.1	Growth shaken down in bottom of flask.
						Sept. 3, "		Neutral.	Growth shaken down in bottom of flask.
						" 8, "		Neutral.	Growth shaken down in bottom of flask.
Ditto.	Ditto.	IV (flask "b").	Ditto.	Ditto.	August 5, 1908.	Aug. 10, '08	Period under Inc. temp.	2.0	Growth size of half dollar.
						" 14, "		2.0	Growth covers one-half of surface.
						" 18, "		1.0	Growth covers three-quarters of surface.
						" 22, "		0.9	Growth complete.
						" 26, "	Room temp.	0.4	Growth complete and partly at bottom of flask.
						" 31, "		0.4	Growth complete and partly at bottom of flask.
						Sept. 3, "		0.4	Growth complete and partly at bottom of flask.
						" 8, "		0.4	Growth complete and entirely at bottom of flask.

TABLE II.—SHOWING THE BEHAVIOR OF KILLED CULTURES UPON GLYCERIN BOUILLON.

Type B. Tuberculosis.	Glycerin Bouillon		Titration Results							
	Flask No.	Reaction to Phenolphthalein. Per Cent. Acidity.	Immediately after Inoculation.	After Heating at 56° C. for 4 hours.	After 4 Days at 10° C.	After 8 days at 10° C. Per Cent. Acidity	After 12 Days at 10° C. Per Cent. Acidity.	After 16 Days at 10° C. Per Cent. Acidity.	After 20 Days at 10° C. Per Cent. Acidity.	After 114 Days at 10° C. Per Cent. Acidity.
(Culture II).										
Human	1	Neutral.	No change	No change.	No change.	0.5	1.0	1.5	3.0	3.2
Ditto.....	2	0.8	" "	" "	" "	0.9	1.3	2.0	2.9	3.2
Ditto.....	3	1.8	" "	" "	" "	2	2.9	3.4	3.4	5.4
(Smith IX).										
Bovine.....	1	Neutral.	No change.	No change.	No change .	No change.	No change.	No change.	No change.	No change.
Ditto.....	2	0.8	" "	" "	" "	" "	" "	" "	" "	" "
Ditto.....	3	1.8	" "	" "	" "	" "	" "	" "	" "	" "
(Smith XII).										
Human.....	1	Neutral.	No change.	No change.	No change.	No change.	No change.	0.3	0.8	3.0
Ditto.....	2	0.8	" "	" "	" "	" "	" "	1.4	2.0	3.2
Ditto.....	3	1.8	" "	" "	" "	" "	" "	2.1	2.5	2.9
(Culture II).										
Avian.....	1	Neutral.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.
Ditto.....	2	0.8	" "	" "	" "	" "	" "	" "	" "	" "
Ditto.....	3	1.8	" "	" "	" "	" "	" "	" "	" "	" "

Again, culture I is the exception to the rule that with tubercle bacilli there is an inverse relation between the virulence and rapidity of growth. It grew profusely from the beginning and never showed the least tendency to lag when transferred from the solid medium to glycerin bouillon. Old cultures of the organism, when kept at room temperature in sealed tubes for more than two years, have remained highly virulent for giunea-pigs and rabbits, 1 mgm. of the culture producing extensive tuberculosis and death of the animals in four to six weeks.

These cases in some respects resemble clinically one reported by T. Smith[15] in 1898; though in his case there was an old lung focus to which he ascribed the subsequent cervical enlargement. He concluded that the rapid multiplication of the bacilli in the glands of the neck was probably due to the fortuitous assistance of other bacteria accidentally present or subsequently introduced. His culture, however, was a human type of tubercle possessing a low degree of virulence.

Histopathological Lesions.

Both in regard to the human and experimental lesions produced by the cultures herein reported there occurred distinct differences in the microscopical appearance, but in no way could these differences be considered as specific for any particular strain. All gradations, from a subacute exudative to a proliferative type of lesion, were observed.

The histopathological differences, as described by Pfander,[16] for fowl tuberculosis, such as (1) a relative scarcity of giant-cells; (2) caseation that is smooth, solid, and hyaline with little tendency to calcify; and (3) a tendency of the tubercle to become surrounded by a connective-tissue capsule, I have observed, but found too inconsistent to be of any differential value. Again, I have not been able to confirm Baumgarten's[17] view that the tubercles in fowls have less leukocytic infiltration than those in mammals. L. Rabinowitsch[3] states that in chicken tuberculosis there is a tendency for the bacilli to be diffusely disseminated and to occur in definite "heaps," which she has never observed in lesions of experimental mammalian cultures, and she regards these differences as peculiar to birds, though not dependent upon any one type of tubercle bacillus. This "heaping" up of the bacilli and their spreading to all parts of the animal body is beautifully demonstrated in Case I, which would suggest an avian infection in man.

In general the experimental lesions fall under three types: (1) The subacute exudative, which is composed of polymorphonuclear leukocytes, lymphoid, and plasma cells without giant or epithelioid cells; (2) one that consists entirely of epithelioid cells without necrosis or exudation, a type of lesion similar to the proliferated endothelium of the Malpighian bodies of the spleen in diphtheria and other acute infectious diseases; (3) the typical

tubercular lesion, consisting of epithelioid, giant cells, and necrosis. All three types of lesion with intermediate stages can be produced with the same culture by grading the dosage according to the virulence and number of bacilli.

Summary.

The four cultures which form the basis of this communication were recovered from peculiar cases of primary cervical adenitis in man, three of which terminated fatally of disseminated acute miliary tuberculosis in four to six weeks.

A careful comparative study shows that culture II corresponds closely with the "human," and culture IV with the "bovine" type of tubercle bacilli; while cultures I and III present variations from the standard types and are to be regarded as "intermediate" or "atypical" forms.

Culture I is of unusual interest because of its remarkable variations. The clinical picture of the case, the rapid course of the infection, the enormous number of the bacilli in the tissues, their tendency to occur in "heaps" like the leprosy bacillus, the high degree of virulence alike for rabbits and guinea-pigs, the production of lesions in chickens, the ease of cultivation, and the prolonged viability under unfavorable conditions, all mark the organism as a decided atypical form of tubercle bacillus in man. The prolonged viability, the production of lesions in the chicken, and the great profusion of bacillary growth in the tissues would indicate an avian type. Though for years the reaction curve was atypical, it has since changed completely to the "avian" curve. In this connection it is of interest to note that L. Rabinowitsch[3] states that she has isolated avian tubercle bacilli from two cases of tuberculosis in man.

Cultures II and III undoubtedly belong to the human type of the tubercle family, though they were under cultivation and were repeatedly tested upon glycerin broth over a period of months before their identity was definitely established.

Culture IV completely corresponds in growth and reaction in glycerin bouillon to the bovine strain; however, it manifests a low degree of virulence for rabbits, which is exceptional for bovine cultures.

The old belief that bovine bacilli are more slender and beaded in the tissues and are thicker and shorter in culture than the human type I have not been able to confirm. The morphological characters of the different cultures here reported were so inconstant that no reliance could be placed on this feature as an aid in differentiation. Outside of the animal body, it would seem that the differences in size and character of the individual bacilli depend largely on the kind and reaction of the medium, while in the animal body they are influenced by their situation and the resistance of the host.

Under artificial cultivation they may undergo a decided change from the slender, beaded rods to the short plump forms, which on egg-medium become almost coccal in character. It is an interesting fact that these cultures, though morphologically alike in the tissues under cultivation, differ distinctly in type.

The nature of the growth of these tubercle cultures varies for the same culture even under apparently identical conditions. The character of the growth was never an indication of the type of the culture. It was common to obtain two distinct types of growth on the same flask of bouillon, *i. e.*, a portion of the surface would be covered with a heavy and uniformly granular layer of closely packed, wax-like colonies twice the size of an ordinary pin's head, while the other portion would be a dense, homogeneous layer with the typical depressed blisters.

The rapidity of growth also varied greatly for the same culture. Often in a series of twelve or more bouillon flasks which were prepared alike and inoculated with the same culture, some would cover the surface in eight days to two weeks, others would take four to six weeks, still others two to three months. It was thought in the beginning of the work that this variation might depend on the amount of oxygen within the flask or on the change in reaction in the bouillon, but further tests proved that neither of these influenced the rate of growth in any way. It would occur in loosely corked flasks as well as in those that were sealed, and in flasks where the reaction was neutral, acid, or slightly alkaline. It would seem that these changes are by no means specific for any group of the tubercle bacilli, but a property possessed by them all.

The growth of the cultures on solid medium showed approximately the same variation as that from the surface of the glycerin bouillon. The wax-like colonies described by L. Rabinowitsch[3] as characteristic for avian tubercle bacilli were noted at times for all of the cultures. On the modified egg mixture the growth was always more rapid and profuse than on any other medium. I found this egg-medium more certain than any other for the direct recovery of the tubercle bacillus from the tissues. Where it was desired to recover the culture from the animal tissues with certainty and celerity it had no equal. Occasionally in seven days after the inoculation of the tuberculous gland material the growth was sufficiently advanced to transplant to the bouillon flasks.

The "brick-red" color that sometimes occurs in the growth of tubercle bacilli I have not observed as a special feature for any of my cultures. It has occurred at times in all; more often perhaps on the egg-medium. A curious feature for some tubercle cultures is the occasional patchy distribution of color, *e. g.*, there will be sharply defined areas of red amid the ordinary wax-like whiteness of the surrounding growth.

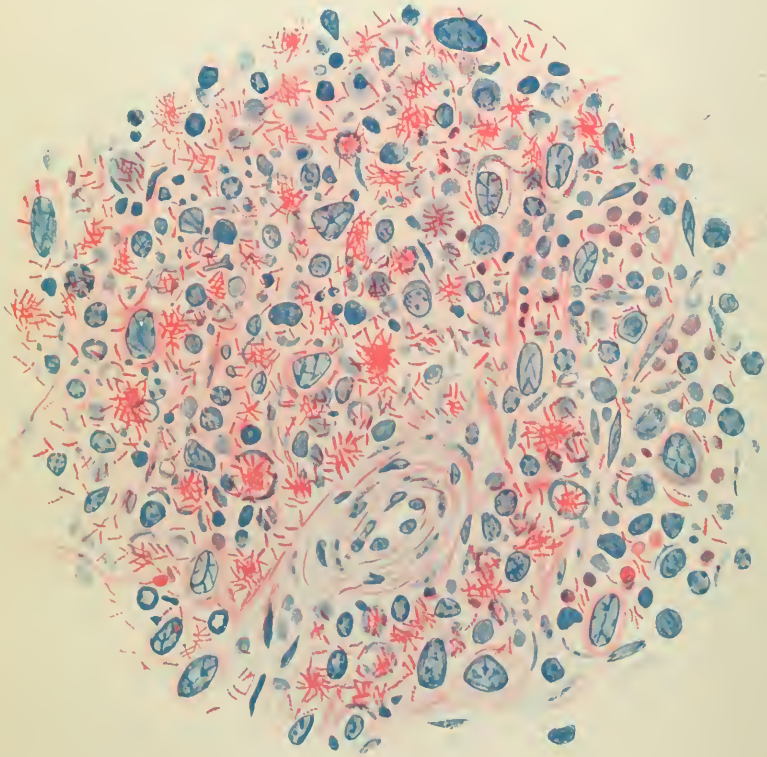

Fig. 1.

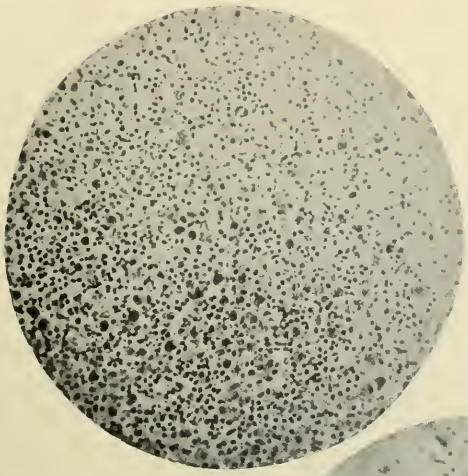

Fig. 2.

Fig. 3 (*a*).

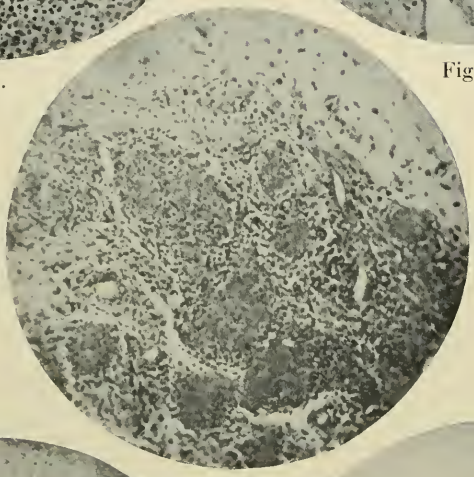

Fig. 4 (*b*).

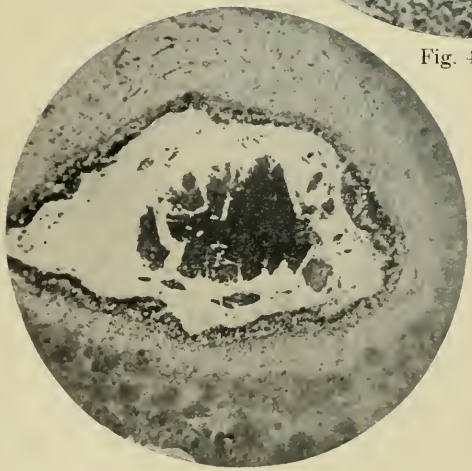

Fig. 5 (*c*).

Fig. 6.

The glycerin-bouillon test serves admirably to distinguish between the human, bovine, and avian types of tubercle bacilli. It is also of value in the determination of degrees of adaptation in man for bacilli of the lower host species, and in the recognition of "intermediate" types. The test, to be of differential value, requires repeated application and careful control over a period of months. Some freshly isolated cultures may produce their specific reaction curve in glycerin bouillon within a few weeks. On the other hand, the same culture may fail to give its characteristic reaction, or any alteration in the glycerin bouillon, for several months, though the growth has been luxuriant and complete.

The rise in acidity that occurs in glycerin bouillon for the human type of tubercle bacilli is due to a specific action on the glycerin of the products of bacilli disintegration (autolysis); with the bovine and avian types the products of bacillary disintegration have no action on the glycerin. The fall in acidity which occurs for all three types of the tubercle bacillus is due to the products of metabolic activity.

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DESCRIPTION OF PLATES.

Fig. 1.—Colored drawing from a section of the human spleen (Case I) to illustrate the enormous numbers of acid-fast bacilli in the tissues. The section is stained in carbol-fuchsin and decolorized in Orth's discharging fluid and then treated with a modified Romanowski stain (Duval).

Fig. 2.—Section of a lymph-node of the rabbit, showing the histological changes that occur after repeated intravenous injections of culture I. Note the similarity of the cellular picture to Hodgkin's disease.

Figs. 3–5.—Illustrate the lesions in the chicken following intravenous and intraperitoneal inoculations of culture I. (*a*) Isolated tubercle in the omentum; (*b*) multiple tubercles in the mesentery; (*c*) large caseating nodule.

Fig. 6.—Sections from the lung of the rabbit inoculated intravenously with culture I. Note the solitary tubercle composed of epithelioid cells and surrounded with a well-defined zone of lymphoid cells.

LA TUBERCULOSIS BOVINA EN CUBA.

ESTUDIO COMPARATIVO DEL BACILO DE ORIGEN HUMANO Y DEL DE ORIGEN BOVINO.

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Havana.

No habiendo observado uno de nosotros (Dr. Dávalos) ningun caso de tuberculosis en el ganado bovino, á pesar de las numerous autopsias practicadas con el fin de estudiar las diversas epizootias reinantes en el país, contrastando éste hecho con la frecuencia de tuberculosos en la especie humana en Cuba, comenzó una investigación minuciosa en las vacas estabuladas en la Ciudad de la Habana. De esta investigación llevada á efecto, en más de ochocientas vacas, pudo comprobar la existencia de la tuberculosis solamente en tres, aislando de ellas el bacilo de Koch.

En la Ciudad de la Habana existen 68 establos con 615 vacas, las que sumadas con 280, que se encuentran estabuladas en vaquerías cercanas á la población, arrojan un total de 895 vacas lecheras. Algunas de éstas vacas muy sospechosas de tuberculosas por los síntomas del aparato respiratorio, fueron sacrificadas, no obstante de no haber reaccionado á la tuberculina, comprobando la autopsia que padecían de bronquitis verminosa (Strongilus micrurus—Strongilus pulmonaris).

Fueron sometidas á la acción de la tuberculina todas las vacas que ofrecían el menor indicio de tuberculosis, no reaccionando más que tres de ellas, las que fueron objeto de las experiencias de que nos ocuparemos dás adelante.

Las informaciones que hemos obtenido de los profesores veterinarios que ejercen en la Habana ó en el campo, y las de los ganaderos están de acuerdo con nuestros resultados. Tambien lo están las que hemos recibido de los inspectores de todos los mataderos de la Isla, en los cuales fueron sacrificados 257,809 bovideos durante el año de 1907.

El médico inspector micrógrafo del matadero, de la Habana, Dr. Ruiz Casabó, nos informa que no ha comprobado ningún caso de tuberculosis en el ganado, á pesar del elevado número de reses que en el matadero han sido sacrificadas y que ascendió al numero de 86,292 durante el año económico de 1907 á 1908.

Es tan rara la tuberculosis del ganado bovino, que algunos de nuestros veterinarios han llegado á negar su existencia en Cuba.

En cambio, las estadísticas de la Ciudad de la Habana demuestran lo frecuente de la tuberculosis en el hombre, según aparece en el siguiente cuadro estadístico de los últimos cinco años.

Años.	Total de Muertes.	Muertes por Tuberculosis.
1903	5,465	1,027
1904	5,583	1,161
1905	5,832	1,179
1906	6,144	1,153
1907	6,708	1,176
1908 (6 meses)	3,051	600

Siendo tan reducio el número de reses tuberculosas en la Isla de Cuba, es evidente que estos animales desempeñan un papel muy secundario ó nulo en la propagación de la tuberculosis en el hombre. El bacilo encontrado en las tres vacas tuberculosas pertenecía evidentemente al tipo bovino, cuyo germen era de esperar no interveniese en la propagación de la tuberculosis en el hombre. Las investigaciones que emprendimos tenían por objeto aclarar éste punto de patogenia.

Los médicos de la prática civil envian diariamente al Laboratorio del Departmento Nacional de Sanidad un gran número de esputos para el diagnóstico de sus enfermos. Estos esputos proceden, por consiguiente, de los más diseminados lugares de la ciudad y de individuos de todas las clases sociales, edades y sexos. Aprovechamos gran número de éstos esputos, que tratamos por los procederes de coloración descritos por el Dr. C. Spengler. con el fin de diferenciar, por su morfolgía y coloración en el esputo mismo, los dos tipos, humano y bovino del bacilo de la tuberculosis.

Estos procederes de coloración son los siguientes:

Proceder A.—1. Preparación seca en cubre-objeto. Alcalinización con solución de potasa cáustica al 1%.

2. Azul de metileno. Löefler—Lávese con agua.

3. Solución carbol-fuschina de Ziehl. Caliéntese sin hervir. Lávese con agua.

4. Azul de metileno otra vez. Agréguese lentamente una ó dos gotas de una solución acuosa de ácido nítrico al 15%.

5. Lávese con agua, séquese y móntese.

Proceder B.—1. Solución Ziehl al calor sin hervir.

2. Alcohol pícrico 2 ó 3 segundos despues del Ziehl. Agréguese 3 ó 4 gotas de la solución de ácido nítrico y de nuevo la solución pícrica 5 ó 10 segundos. Lávese, séquese y móntese.

Por éstos procederes se destacan intensamente coloreados los bacilos de Koch. Los del tipo humano deben aparecer largos y por lo general aislados ó en pares. Los del tipo bovino aparecen más cortos, á veces en forma irregular y con frecuencia agropados ó en masas.

En más de 100 esputos examinados por nosotros en la forma descrita, encontramos los caracteres morfológicos del tipo humano. En tres casos que los bacilos aparecían irregulares, cortos y agrupados en masas, pudimos comprobar, por la experimentación en el conejo, que se trataba del mismo bacilo tipo humano.

Con disoluciones en agua esterilizada de estos tres esputos, se inyectaron varios cobayas. Cuarenta dias más tarde fueron sacrificados, encontrándose cerca del punto de la inoculación un ganglio muy aumentado de volumen y conteniendo una substancia caseosa. Bazo é hígado aumentados de volumen é invadidos por una tuberculosis miliar. Las preparaciones coloradas evidenciaron el germen inyectado.

Se hacen siembras del ganglio y del bazo en el medio de heuvo de Dorset. Examinadas éstas siembras á los 13 dias, se encontró un bacilo corto é irregular, curvo, estrechado en el centro, con un engrosamiento en una de sus extremidades. En vista de éste resultado, se inyectaron varios conejos: unos subcutaneamente con 0.01 gr. de los bacilos aislados, previamente disueltos en agua esterilizada, y otros con 0.002 gr. intravenosamente. Estos conejos fueron observados durante unos cinco meses, sin que ofrecieran otra novedad que la de un nódulo enquistado que, por algún tiempo, presentaron en el punto de la inoculatión, los que habían sido inyectados subcutaneamente.

De distinto modo se comportaron los conejos que habíamos inyectado con bacilos procedentes de las tres vacas atacadas de tuberculosis bovina. En ellos pudimos comprobar como exactos los resultados señaldaos por el Dr. A. Weber en su artículo "Tuberculosis" del tratado de Wassermann y Kolle. Los conejos inyectados subcutaneamente con 0.01 gr. del bacilo procedente de las tres vacas, murieron tuberculosos en un intervalo de uno y medio á cuatro meses, y los inoculados intravenosamente con 0.002 gr. del mismo bacilo, sucumbieron tuberculosos en el corto periodo de unos 20 días.

Paralelamente con nuestra experimentación en los conejos, se hacían cada día más exhuberantes los cultivos procedentes de los cobayas inyectados con los esputos en el medio de huevo de Dorcet, demostrando al microscopio un bacilo largo, morfologicamente idéntico al bacilo de tipo humano.

Ensanchando la esfera de nuestras investigaciones sobre la tuberculosis bovina en la Isla de Cuba, emprendimos una série de experiencias con objeto de fijar los principales caracteres diferenciales que comprobásemos entre los bacilos tipo humano, y tipo bovino tanto por su morfolgía y modo de comportarse en los medios de cultivo, como por su virulencia para los distintos animales.

Para confirmar la hípotesis de que existen diferencias esenciales y permanentes entre ambos tipos, apelamos á la experimentacíon en conejos y bovídeos como medio de diagnóstico. En los primeros los gérmenes de una

y otra procedencia se comportan siempre como hemos dicho. En los bovídeos las diferencias fueron tambien muy marcadas, requiriendo la experimentación un periodo mucho mas largo de tiempo.

Dos terneras previamente tuberculinizadas, para comprobar que no eran presa de la tuberculosis, fueron sometidas á la siguiente experimentación: A una de ellas, se le inyectó debajo de la piel del cuello $\frac{1}{3}$ de la disolución de un cultivo de 25 días en el medio de huevo de Dorcet, de bacilos procedentes de una de las tres vacas tuberculosas antes citadas. La otra ternera fué tambien inoculada en la misma región con igual cantidad de un cultivo de 25 días en el mismo medio nutritivo, pero el germen procedía de un esputo humano.

A los dos meses de ser inoculada la ternera con el germen bovino, se comprobó un pequeño tumor del tamaño de un huevo de gallina en el punto de la inoculación, á la vez que un ligero infarto de los ganglios del cuello del mismo lado. A los cuatro meses se le inyectó tuberculina ofreciendo una evidente reacción positiva. A los seis meses el tumor y los ganglios del cuello habían aumentado considerablemente de volumen. Se incindió el tumor y dos de los ganglios, apareciendo en ellos una substancia caseosa que, examinada al microscopio, evidenció la presencia del bacilo de Koch. A los once meses fué sacrificada la ternera, comprobándose en la autopsia una tuberculosis generalizada. Los ganglios brónquicos y mesentéricos estaban invadidos, las pleuras ofrecían multitud de tubérculos esparicidos en grupos, los vértices de ambos pulmones tuberculizados, el bazo voluminoso y totalmente invadido.

La ternera inoculada con tuberculosis de origen humano sólo presentó un pequeño tumor en el punto de la inyección, sin resentirse los ganglios del cuello. A los doce meses no reaccionó á la tuberculina. Al año y medio fué sacrificada sin hallarse en la autopsia el menor vestigio de tuberculosis. El tumor del cuello adquirió el tamaño de un pequeño huevo de gallina y después de abierto se comprobó que estaba rodeado de un tejido fibroso, á la manera de un quiste, conteniendo una substancia caseosa, homogénea, en la que ni las preparaciones directas ni las siembras pudieron demostrar la presencia del bacilo de Koch: en una palabra, el contenido del tumor era aséptico.

Tambien hemos de consignar que una de las tres vacas tuberculosas que estudiamos, fué adquirida con un ternerito de dos meses, que lactaba de su madre, la cual le transmitió su enfermedad, siendo sacrificado más tarde por ofrecer el síndrome característico de una tuberculosis generalizada, que fué comprobada en la autopsia.

Las siembras del bacilo de uno y otro tipo en agar glicerinado, heuvo de Dorcet, papa glicerinada, caldo glicerinado y suero glicerinado p gelatinizado no se comportaron de igual manera: las del tipo humano se desarrollaron con más rapidez y exhuberancia que las del tipo bovino.

En las siembras de ambos gérmenes en caldo glicerinado, con una acidez de 2%, comprobamos que el bacilo tipo humano germinaba con facilidad, contrastando con la germinación tardía y ténue del bacilo tipo bovino.

Un caracter distintivo de ambos bacilos, que entendemos merece ser consignado, por haberlo observado constantemente en nuestras experiencias, consiste en la facilidad con que se disuelven en solución salina las colonias del tipo bovino, mientras que la disolución en el mismo medio de las colonias del tipo, humano se consigue con dificultad.

Respecto á la morfología de ambos bacilos, hemos de consignar que en las primeras generaciones en los medios de cultivo ambos gérmenes aparecen cortos, de una longitud doble á su diámetro, adquiriendo después una mayor longitud, que se acentúa más en el humano que en el bovino.

De las investigaciones antedichas se deduce:

1. Que es rara la tuberculosis bovina en Cuba.
2. Que existen diferencias positivas entre el bacilo tipo humano y tipo bovino.
3. Que la tuberculosis observada en el ganado vacuno, es debida al bacilo tipo bovino.
4. Que en Cuba no se ha comprobado el origen bovino de la tuberculosis humana.

THE INTERTRANSMISSIBILITY OF TUBERCULOSIS.

By Charles F. Dawson, M.D., D.V.S.,
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Since the researches of Dr.Theobald Smith in 1896 and 1898 on the biology, morphology, and pathogenesis of bovine and of human tubercle bacilli, the study of the intertransmissibility of tuberculosis has assumed great importance.

Following the work of Smith came the now famous declarations of Koch, denying the unity of human and bovine tuberculosis, and also doubting that they are intertransmissible.

The scientific world was at once moved to take notice of these statements, and commissions were appointed to investigate the correctness of Koch's assertions. If the Koch idea could be shown to be well founded, it was evident that sanitary measures restricting the sale and movement of tuberculous animals and their products were unnecessary, and that they were harmful to the cattle industry. More important still was the probable removal of apprehension concerning the influence of diseased animals and their products upon the public health.

It has now been about seven years since Professor Koch first agitated the question of the intertransmissibility of tuberculosis in a memorable address before the British Congress on Tuberculosis.

A summation of the views of various authors shows a preponderance of opinion against Koch's theory. Indeed, it would seem that while Koch's statements have generally failed to create converts to his theories, they have served to call the attention of the whole professional and lay world as well to the great prevalence of cattle tuberculosis, and to the question of its transmission to man. Therefore the agitation has been productive of an immense amount of good, and has served to interest our lawmakers, who, heretofore, have generally regarded the question with suspicion, and those who agitated it as faddists. Of equal importance has been the effect of Koch's statements upon the scientific world. Coming, as they did, from such an eminent authority on tuberculosis, pathologists at once began to investigate tuberculosis with renewed vigor and from every conceivable standpoint. So that to-day this terrible scourge of man and of our principal meat-producing animals is receiving the attention from pathologists that its tremendous importance demands.

It is admitted by all authorities that bovine tuberculosis is rapidly increasing in extent in civilized countries. In the United States it is impossible at present to present accurate statistics, owing to more or less laxity in the enforcement or absence of law for protecting the health of persons and of animals. Enough is known, however, to cause us to view with alarm the probable effect upon the public health by the disease if it is allowed to continue its ravages. Statistics seldom give a correct idea of the prevalence of diseases. This is particularly true of the statistics of tests for tuberculosis in the United States, for the reason that the tests are generally made in herds where there is reason to suspect the disease is present. Were all cattle tested indiscriminately, it is probable that the percentage of cases would be materially reduced. In Massachusetts, where 24,685 cattle in suspected herds were tested, 12,443, or 50 per cent., were found tuberculous. In the same State, 4093 cattle in non-suspected herds furnished 1080 reactors, or showed only 26.4 per cent. tuberculous animals. In experiment station tests in suspected herds 115 out of the 323 head that were tested proved tuberculous—a percentage of 35.6. In non-suspected herds 84 out of 935 head proved tuberculous, or only 9 per cent.

At present the disease is confined largely to dairy cattle, as is shown in our Federal statistics for the year 1900, in which nearly 5,000,000 inspected carcasses of beef animals showed only about 0.11 per cent. tuberculous.

Statistics also show that the disease prevails in swine in proportion as they come in contact with infected cattle. In fact, swine tuberculosis is now taking high rank as the most important swine disease which may affect the public health. In swine the disease is usually generalized, and thus more edible portions of the carcass consumed, and the chances of infection are to this extent increased. Porcine tuberculosis is found most prevalent in hogs fed on dairy refuse from infected dairy cattle, and where they have access to cattle manure. That swine readily contract tuberculosis from the ingestion of artificially infected milk, from feeding behind cattle affected with natural tuberculosis, from feeding behind cattle affected with tuberculosis by drinking artificially infected water, and by the subcutaneous injection of virulent tubercle bacilli, has been demonstrated by Schroeder and Mohler, of the Bureau of Animal Industry. The same authors demonstrate that the feces of a tuberculous cow are more certainly infectious than her milk. This is true because the lungs are more often the seat of the disease than is the udder, and because it has been shown that tubercle bacilli are swallowed by cattle instead of being coughed up and expectorated, and that they pass through the bovine digestive canal and are discharged with the feces without having lost their original virulence.

We are thus brought face to face with the fact that when a cow's lungs are sufficiently involved to cause her to discharge tuberculosis bacilli, she be-

comes a disseminator of tuberculosis, regardless of the question of her udder being diseased. The fact that there is extreme care, as regards cleanliness, in milking operations about such animals is no guarantee that the milk is free from tubercle bacilli.

Not only is the public health menaced by the presence of tubercle bacilli in fresh dairy products in which they retain all their original virulence, but it has been shown by several investigators that tubercle bacilli live and retain their virulence for several months in ordinary butter. The writer conducted an experiment in which it was shown that tubercle bacilli retain their original virulence in ordinary butter for a period of three months, and even after a period of eight months the same butter was capable of producing the disease in guinea-pigs.

We thus see that one cow in a herd may affect her calf by the bacillus-laden manure which soils her teats and adjacent parts; that this manure may infect the milk; that her milk, when added to the milk of perfectly healthy cows, will infect the whole supply from that herd.

Schroeder has shown that it requires only a single nursing of a tuberculous mother-cow to infect her offspring. He allowed three sucking calves to nurse a tuberculous cow one, three, and seven days respectively. A fourth calf was fed the milk from a pail for thirty days. All other sources of infection were excluded. All four calves contracted tuberculosis.

A single tuberculous cow that is passing the bacilli in her feces will infect a whole stable sooner or later. Her manure, mixed with that of healthy individuals, will infect the whole manure pile, and this, if swine have access to it, will become infectious for them.

If, as Koch claims, man cannot contract tuberculosis from the lower animals, our interest in the matter, outside the question of the palatability of tuberculous meats and dairy products, would be confined largely to the inconveniences of a restricted diet and of financial losses. However, the preponderance of evidence favors the view that all forms of tuberculosis, from that found in man, even to that found in cold-blooded animals, are identical. That the variant types of tubercle bacilli are the product of environment receives confirmation from our laboratory experiences with the pathogenic bacteria, which all workers know show variations in morphology, biological properties, and pathogenesis, according to the medium, age of culture, passage through various animals, and other environmental influences of which we are probably now ignorant.

Already a large amount of work has been done which shows that tuberculosis is an intercommunicable disease. It is admitted that the human bacillus is less virulent for the animals than is the bovine bacillus. This was shown by Sidney Martin as far back as 1895, and has since been demonstrated by others. While these observations are of scientific value, they can be

explained in the light of our knowledge to-day. We now know that the virulence and morphology of a particular type can be changed at will.

Nocard, in 1898, transformed human bacilli which ordinarily were non-pathogenic for fowls into a pathogenic avian type by successive cultivations in collodion sacs in the peritoneal cavity of fowls.

Delépine found great variation in the virulence of human bacilli, and by using a mixture of human sputa, easily produced tuberculosis in a calf, cultures from which showed a great increase of virulence over the original bacilli.

Römer passed an old laboratory culture of human bacilli through a goat, which animal is somewhat resistant to tuberculosis, and found that the bacilli were exalted in virulence for cattle and sheep. Not only was the virulence increased, but there were morphological changes toward the bovine type, and it grew less luxuriantly on artificial media. He also transformed the avian type into the mammalian type by passage through guinea-pigs and rabbits, to the extent that the lesions produced were similar to those produced by the mammalian type. He also revived the artificial cultural capacity of different types by passages through white mice.

Moeller found that a single passage of the human type through a guinea-pig exalted it in virulence for guinea-pigs.

Dinwiddie was able to transform the bovine type to the porcine type by passage through swine. These changed characters persisted in subsequent cultures and inoculations.

Wiener isolated a human type from a horse which was virulent for fowls. Collodion-sac cultivations in the bodies of fowls changed the type from human to avian.

Karlinski found that the virulence of human bacilli can be increased by passages through guinea-pigs or cattle to a point where they produce generalized tuberculosis in cattle, and where they do not differ materially from the bovine types.

Mohler and Washburn, by the rapid passage of sputum bacilli through a series of five cats, report a great increase in their virulence for young cattle.

Dieudonné, by the repeated passage of mammalian bacilli through frogs, observed a gradual increase of virulence for cold-blooded animals and an approach to the type found in fishes and frogs.

Arloing found that human sputum bacilli vary in virulence from one extreme, where they readily produce generalized tuberculosis in guinea-pigs and rabbits, to the other extreme, where they are harmless to rabbits and but slightly affect guinea-pigs. The virulence of the weak variety could be exalted so as to readily affect guinea-pigs and rabbits by passage through two or three guinea-pigs.

It will be seen from the foregoing that tuberculosis affects a wide range of

species of animals, and that the bacillus undergoes very important changes according to environment. The bovine type is pathogenic for horses, cattle, sheep, swine, dogs, cats, guinea-pigs, and rabbits, a range of pathogenic power that is not possessed by any other microörganism that is not also pathogenic for man.

From the nature of things we cannot, by experimental data, such as the foregoing, prove the communicability of animal tuberculosis to man, but sufficient evidence is at hand to convince us that man does contract tuberculosis by contact with and by the use of the edible products of tuberculous cattle.

Salmon, in Bulletin No. 33, Bureau of Animal Industry, cites the following cases which show clearly the danger from this source confronting the human race: Three cases of skin tuberculosis due to accidental inoculation with the bovine bacillus. Veterinarian Moses wounded his thumb while making an autopsy on a tuberculous cow. The wound healed, but at the end of six months a cutaneous tubercle had formed, and the patient died of phthisis in eighteen months. A man engaged in cleaning a cattle car was wounded upon the back of the hand by a piece of the broken woodwork of the car. Tuberculosis developed at the wounded surface and was treated by a physician. The patient's health declined and he died of generalized tuberculosis within a year.

A physician was called to treat a six-year-old girl for supposed ivy poisoning. Fresh cream had been applied to the affected parts at home. Tuberculous ulcers developed where the cream had been used topically. Two rabbits, inoculated with some milk from the same cow, developed tuberculosis. Likewise, a rabbit inoculated intraperitoneally with caseous material from the girl's leg developed fatal tuberculosis.

A similar case was where a girl, who had a wound on the finger, became infected by milking a tuberculous cow. Within six months more than sixty subcutaneous abscesses developed in various parts of the body. The nature of these lesions was determined by the inoculation of a rabbit.

A sailor tried to remove tattoos from his arm by pricking milk into the marks with a needle. Lupus developed, and the man made a recovery after surgical measures were taken.

These cases show as plainly as an experiment well could that bovine tuberculosis can be communicated to man in a fatal form by subcutaneous inoculation.

That bovine tuberculosis is communicated to man by the ingestion of the products of tuberculous cattle is just as plainly shown by the following cases, also cited by Salmon:

Twelve girls, at a boarding-school, contracted tuberculosis, and five of them died of the intestinal form of the disease. An examination of the cow

which furnished the school with milk revealed extensive tuberculosis of the intestines and udder.

The daughter of a physician was accustomed to visit her father's farm on Sundays, and while there, to drink freely of milk. She became ill and died in ten months. A post-mortem examination revealed tuberculosis of the abdominal viscera and mesenteric glands. On examination of the herd, four of the five cows comprising it were found tuberculous, two having disease of the udder.

A child twenty months old died from abdominal tuberculosis three months after having visited its uncle's farm, where it was fed milk from the family cow. The child's sickness began a few weeks after its return home. It had previously been in perfect health, as were also its parents. When the cow was examined, she was found to have generalized tuberculosis.

Two young daughters of a healthy family were raised on milk from a tuberculous herd, and both contracted tuberculosis, while two older brothers, who used little or no milk, remained well.

A previously healthy man was treated for six weeks for supposed typhoid fever. As the expected convalescence did not occur, a consultation was had, and a diagnosis of acute miliary tuberculosis was made. Shortly after, the man's one-year-old child came down with meningitis of supposed tubercular origin, no post-mortem being permitted. Both parent and child had drunk largely of milk from a cow which a subsequent test and examination showed had extensive tuberculosis of the lungs, peritoneum, and udder.

These cases could be extended in number, but are sufficient to show, beyond a reasonable doubt, that the disease can be communicated from cattle to man through the use of the products of tuberculous cattle and by subcutaneous inoculation.

At the conclusion of the Joint Session arrangements were made for the continuation of the discussion on the following morning. The Joint Session of Sections I and VII was therefore concluded on Thursday morning at the New Willard Hotel, Dr. H. M. Biggs presiding, in the absence of Dr. Pearson and Dr. Welch, whose duties required them to conduct the regular programs of their respective Sections. The report of the conference at the New Willard Hotel follows.

The Conference on the Relations of Tuberculosis of Animals and of Man,

At the New Willard Hotel, Washington, D. C.,

Thursday, October 1, 1908;

CONTINUING THE JOINT SESSION OF SECTION I AND SECTION VII.
(In Camera.)

The participants in the discussion at the Joint Session of Sections I and VII met at 9 o'clock on Thursday morning, October 1st, in the New Willard Hotel. The presidents of Section I and Section VII being absent on account of the regular Section meetings, Dr. Herman M. Biggs was asked to preside. It was understood that the proceedings of this conference were part of the proceedings of the Congress, in the Joint Session of Sections I and VII.

Verbatim notes were taken by Mr. Whitman, the official stenographer of the American Medical Association. The following report is derived in part from the account published in the "Journal of the American Medical Association" (October 10, 1908) and in part from the later account published in "Tuberculosis" (November, 1908) over the editorial signature of Professor G. Pannwitz, Secretary-General of the International Antituberculosis Association.

Dr. Biggs called the meeting to order at 9 o'clock.

Dr. Herman M. Biggs (New York): It is understood by all of you that this conference was arranged at the suggestion of Professor Koch, for the purpose of discussing somewhat informally and privately the questions of the connection between human and bovine tuberculosis which are of such enormous theoretical and practical importance; and it is the understanding that what is said here is simply for the information of those who are interested in this work and in the bacteriological problems involved. I hope all those who are present will keep this in mind.

I will now ask Professor Koch to open the discussion.

Prof. Koch: A great difference of views seems to prevail with regard to the question of human and bovine tuberculosis, and I am glad that we have

an occasion to enter into the subject in detail. I trust we may be able to prepare an understanding in the matter, although I do not believe that perfect agreement of the various views will be obtainable, as each author, having taken much time to build up his opinion, will be inclined to cling to it until his life's end. What mostly impedes an understanding is the difference of languages, and the necessity to translate the remarks of the various speakers into several languages, so that a possibility of incorrect interpretation can arise. I would, therefore, urgently beg the various gentlemen to make their remarks as concise as possible, and to keep strictly to the subject without any superfluous additions.

I would specially propose two points for discussion, the first referring to the remarks of Mr. Fibiger, who contends that bovine tuberculosis is very frequent in man. I wish to state again on this occasion that I have never denied that bovine tuberculosis is found in man, but I contend that these cases are rare. Secondly, I would refer to the statement I made on Wednesday last in the Congress, to the effect that not one single authentic case of phthisis has ever been found in man where for any long period of time bovine tubercle bacilli have been coughed out by the patient. I would specially ask the question whether any case of pulmonary tuberculosis exists in which tubercle bacilli of the bovine type were found, not once, but repeatedly.

I propose that we should discuss this second point first, and I ask: Has any one of the gentlemen present ever seen such a case of bovine tuberculosis in man? [Pause.] It appears that nobody knows of such a case. The German Commission for research—that much is known to the members present—found no such case among 22 cases investigated. As regards the work of the British Commission, I may mention the fact that one of the animals became infected with bovine tuberculosis after being fed with human sputum, but that this case cannot be given weight as proof. Moreover, it appears that in these experiments a large number of sputa, obtained from a plurality of patients, have been given. Perhaps Dr. Woodhead may be in a position to furnish full information on the subject and make definite statements on the series of experiments. A number of experiments with sputum collected from many consumptives have been made, in which the results were negative.

The Chairman: Is there any one here who can report such a case as Professor Koch has asked for?

Prof. S. Arloing (Lyons, France): I claim to have identified such a case, or discovered such a case in which the bovine bacillus was isolated. An autopsy was performed, and in a cavity the tubercle bacillus was found, and a culture made from it which possessed all the cultural characteristics of the bovine tubercle bacillus, and which, when injected into an animal of the bovine species, produced a generalized tuberculosis.

Prof. Koch: The case on which Professor Arloing reports and his conten-

tions are known to me, but the finding of a single case of bovine tuberculosis in a cavity cannot be considered as proof; the case would only show proof if the bovine tubercle bacillus had been found repeatedly and during a certain period of time. In this connection I would call attention to the possibility of accidental contamination with milk or butter or other food substances, which must always be kept in view; even if the bovine tubercle bacilli are found in a cavity after death, the possibility must always be thought of that the patient, in the course of his last hours of life, may have inhaled particles of vomited contents of the stomach or contents of the mouth cavity, and that the infection of a tuberculous cavity with the bovine type may have come to pass in that way. One isolated observation of this kind has not the necessary power of proof, and only experiments of utmost exactness, and excluding every possibility of secondary contamination, can be taken into account.

THE CHAIRMAN: I will now call on Professor Woodhead to say a few words.

PROF. G. SIMS WOODHEAD (Cambridge, England): I quite agree with His Excellency, Professor Koch, that it may be well for us to keep to one or two points. From my point of view, it is somewhat unfortunate that the second point should have come up for consideration first. I say that because I am not in a position to say very much about the second part, as we have in our second interim report published only that part of our investigations, as regards the bovine type of bacillus, which deal with alimentary tuberculosis or tuberculosis associated in some way or other with the alimentary tract. I quite admit that Professor Koch's criticism as regards that single experiment or a small group of experiments must carry some weight. I may say that the first experiments made by us were carried out for a considerable length of time, as we intended to feed for such a long period, and we started at once with material which perhaps now we should scarcely accept, but it was material that was taken from the Brompton Hospital for Consumptives. It was strongly impressed on those who had charge of the collection of this material that it should be as pure as possible, and all possible precautions that could be taken as regards this sputum were taken. It was not a single specimen of sputum. The sputa came from different sources, from selected cases, and therefore we do not lay any very great stress—and I think Professor Koch will bear me out in this— on these cases. They gave, as it were, an indication of what we might expect to find. There is included in the appendix of our report every single experiment that has been made. We have kept nothing back. We have given all details, and we would like those who do not agree with our findings to examine the data on which those findings were arrived at. Therefore, I do not feel in a position to say very much about the question of the typus bovinus in the lung. At the same time, I can assure you it is a question that has not been overlooked, and I can also, I

think, assure Professor Koch that the conditions or requirements he laid down have been and are being carefully attended to. We have gone into this matter in as absolutely an impartial state of mind as is possible for five men of somewhat different opinions to do. We have received the assistance of very able men, who have looked at this thing from different standpoints. Dr. Eastwood, Dr. Corbett, and Dr. Griffith have undertaken a detailed investigation. They have all of them naturally acquired a very great amount of experience in this kind of work. They are fully impressed with the practical points laid down by Professor Koch, and whatever our results may be, I can assure you they have been arrived at by taking into consideration the work of others and comparing it with the work that is being done on our farms. We cannot do any great amount of clinical work; that has been impossible, as other work has been so important, and when we come to the discussion of the first point that has been suggested, I shall have something to say. But I cannot claim that we have done any special work that we can publish at present. We cannot claim that we have found any case except the one referred to by Professor Koch. As he has pointed out, there are certain criticisms which are perfectly legitimate, and we do not wish to lay stress on that aspect of the question at all; at the same time, I think it only fair that I should mention what is being done, and that we have not lost sight of the point.

Prof. S. Arloing: I know that Professor Koch accepts the reality of the finding of a large number of bovine bacilli in the lung, but he believes that this may have occurred by contamination from food. I wish to say that this patient was for a long time in a hospital where the bovine type of bacillus should be a rarity, and if contamination took place through the food, such contamination must have been by means of a dried bacillus. But the anatomical contents of the cavity examined, namely, in the lung, showed the presence of virulent bovine bacilli in great numbers, so that the finding of the bovine type of bacillus in very great numbers in the lung would show, at least, that human tissue is a suitable culture-medium for the bacillus of the bovine type.

Prof. Koch: There seems to be a misunderstanding between Professor Arloing and myself. I do not doubt that he has found the bacilli of the bovine type in the lung, but this is only an isolated case. I repeat that we may be dealing here with an accidental admixture.

Prof. S. Arloing: I admit that my researches were not strictly in conformity with all the requirements of Professor Koch,—that is, constant and prolonged research in this matter,—but these bacilli were found during the life of the patient, and, therefore, precluded the supposition of Professor Koch that the occurrence of this infection was at a moment of agony. I wish to repeat that the multiplication of these bacilli in the tissue shows adaptability of human tissue to the bovine bacillus.

PROF. THEOBALD SMITH (Boston): The question before us is one of methods. In the study of the tubercle bacillus with special reference to its differential characters we would hardly apply the same methods to-day which we applied ten or fifteen years ago. Now we must determine not only whether the bacilli associated with a certain disease are bovine or human, but we must guard against being deceived by mixed cultures or by the accidental presence of one or the other type. I think the demand made by Professor Koch a reasonable one. In the final determination of bovine tubercle bacilli as a cause of pulmonary tuberculosis there should be repeated examinations of the same case, to find out whether the bovine bacilli actually multiply there and continue to be thrown off in sputum. Unfortunately, I am not familiar with the details of the original paper by Professor Arloing, and I am, therefore, unable to make any comments on it which may have any weight. However, in a problem of such importance as this, where the existing evidence may be made to point both ways, we must begin over again in the collection of scientific evidence. What has been reported thus far can only be considered presumptive. The presence of large numbers of bacilli in the lungs, in the case mentioned by Professor Arloing, cannot be safely used as an argument, because they may have been human bacilli admixed with a few bovine by accident, as Professor Koch points out. We know that there are human bacilli of such low virulence toward guinea-pigs that they may be lost after inoculation and only the virulent bovine type persist. Finally, the difficulties and pitfalls surrounding the bacteriological study of diseased organs in open communication with the air and the digestive tract are well known. The study of lymph-nodes presents fewer difficulties.

DR. LEONARD PEARSON (Philadelphia): It occurs to me, from the remarks of Professor Smith, it may not be clear that this organism which Professor Arloing discovered in the lung of man was proved by him to be virulent for cattle. It was not a non-virulent organism in the lung, and was, according to his understanding, of the bovine type.

DR. RAVENEL: Am I right or wrong in understanding that the German Commission has ascertained the bovine type of the bacillus to be the cause of a case of miliary tuberculosis of the lungs?

PROF. KOCH: I have asked whether any case exists of tubercle bacilli of the bovine type in pulmonary tuberculosis, and not in miliary tuberculosis.

DR. RAVENEL: Am I right or wrong in saying that the German Commission has published a case of that kind?

PROF. BANG: I think you are right.

DR. T. SMITH: These are two quite different things. Generalized tuberculosis can cause death long before any tubercle bacilli are ripe for colonization in a case of pulmonary tuberculosis.

DR. RAVENEL: That may be correct; but is not acute miliary tuberculosis of the lungs phthisis?

PROF. KOCH: No, it is not.

PROF. FIBIGER: I would ask whether Professor Koch remembers an authentic case of bovine tuberculosis in man which is described by Dutch authors.

PROF. KOCH: I know that case very well. It is a case of this type; but it has the defects which have been inherent in the earlier investigations. Besides, the same objections apply to this case as to that mentioned by Professor Arloing, viz., that the case represents but one single finding. In order to arrive at definite conclusions, the greatest care with reference to the conditions stipulated by me must be taken in future in all cases investigated and reported. I do not consider this question as settled either in one sense or in the other, before all inexact cases which are unsuitable for proof are absolutely cleared up.

THE CHAIRMAN: Unless there is objection, we will now pass on to the consideration of the second question, and I will ask Professor Koch to speak.

PROF. KOCH: I would ask the following question: How often does primary intestinal tuberculosis or tuberculosis of the mesenteric glands occur in children? It has been said by some that primary intestinal tuberculosis occurring in children is due to bacilli of bovine tuberculosis. I contend that this form of tuberculosis is not frequent, and in support of this assertion I refer to Virchow, Orth, Albrecht, Baumgarten, and others as authorities who have said, and still say, that primary intestinal tuberculosis is an extraordinarily rare disease. [Professor Koch read the following passage from the newest work of C. Flügge, "Die Verbreitungsweise und Bekämpfung der Tuberkulose auf Grund experimentaler Untersuchungen im hygienischen Institut der Königl. Universität Breslau"—"The Experimental Researches Carried Out at the Hygienic Institute of the Royal University of Breslau," 1908, p. 411.]

"If some few authors are of a different view, and Fibiger and Jensen, for instance, find primary intestinal tuberculosis in the case of about 6 per cent. of all patients and of about 11 per cent. of all tuberculous patients, and in children even of 16 per cent., Baumgarten considers this figure 'as far too high,' and says: 'Primary intestinal infection is very rare, according to my experience, and most pathological anatomists agree with this view.' Virchow, Orth, Ribbert, Albrecht, and many others have expressed their opinions to quite the same effect. Orth found among 131 children only 1.5 per cent. of unquestionable tuberculosis of the intestinal and mesenteric glands; Biedert, among 3104 sections of tuberculous children, found primary intestinal tuberculosis 16 times, *i. e.*, 5 cases in 1000. Baginsky found no case in 933, Grosser only one case among 1407 sections of tuberculosis in the Pathologic Institute of Tübingen."

Thus it is seen that the views of the pathologic anatomists widely differ

from each other. I have discussed the question with Orth among others; his personal view certainly differs from that of Heller's assistants, as far as autopsies in Berlin are concerned.

I would now ask: Whence comes this great difference? Are there local differences in the pathological material of the various localities, or must the difference of opinion be looked for in the subjective understanding or subjective interpretation on the part of the various prosectors and pathological anatomists who carry out the autopsies? This question remains undecided. The question of the frequency of primary intestinal tuberculosis I consider settled thus far, that, in my opinion and in that of other authorities, the occurrence is very rare. If we consider that eleven-twelfths of the tuberculous deaths are due to pulmonary tuberculosis and only one-twelfth is caused by all the other forms of tuberculosis together; if we take into account that, of these again, only a small part can be due to primary intestinal tuberculosis, and that, once more, only a small part of them belongs to bovine infection, we must admit that bovine infection is a rare clinical occurrence.

Prof. Woodhead: I must say that when Professor Koch stated in London that primary feeding tuberculosis was very rare and actually seldom or never occurred——

Prof. Koch: I said it was rare.

Prof. Woodhead: While at Edinburgh, as pathologist, I made a great number of post-mortem examinations, and I have taken the different records, before this question came to the front so prominently (it was back in the '80's), of some 119 cases, and have come to the conclusion that 14 per cent. of these were due to alimentary tuberculosis. It first made me think that this might be the result of alimentation and the conditions in that city. I went into the question, and I found what appeared to be confirmatory evidence on this point, that no child up to one year of age became affected, but immediately after there was a sudden rise in the number of cases. This, of course, is ancient history, but it certainly was a very striking fact to hear that in Germany so few of these cases occurred. A commission was appointed, as you will remember, and we examined 60 cases of tuberculosis of human origin; that is, the material taken from 60 cases. You will remember that we divided the bacilli from these cases into two groups, with a third undifferentiated group. We have not fully made up our minds as to this third group, but we have undoubtedly two very different groups of bacilli, and we have arrived at the same conclusion as Professor Kossel has, namely, that these must be looked on not as distinct species, but we must take them provisionally as types. We separated 14 cases, which were undoubtedly virulent, from the bovine species. They appear to have the specific characters of the bovine type of bacillus. We found ten of these were taken from cases in which there were primary lesions, and you may be assured that we are very careful in our

selection and description of these cases. They were primary lesions of the abdominal tract. At any rate, we put them down, according to the evidence we had, as being cases of abdominal tuberculosis; so that we have ten cases in children from which we were able to separate a special type of bacillus. It was undoubtedly a virulent organism when tried on cattle and rabbits, and it had the general characters. We do not lay quite so much stress on the differential characters as many appear to do, because we find they are sometimes unreliable. We have found also three cases of tuberculosis of cervical glands similar to those described, in which we got the same results. These were to a certain extent selected cases, and after what we have heard you may imagine we were very anxious to get a number of these cases of abdominal tuberculosis. We have found since that we had no need of extensive search, since a considerably larger number of cases have been submitted to us than we had any idea of. So far as our experience goes, this form of abdominal tuberculosis is not by any means so rare as stated in the statistics cited by Professor Koch. Whether these people are biased or not (and we are all biased sometimes), I think that you will agree with me that five or eight people working together, in a scientific study, are not likely, in a doubtful matter, to be practically unanimous, as we have been in all these cases. We regard them as cases of primary abdominal tuberculosis. If eight people looking at the question from somewhat different standpoints differ, then they must be excluded as being of the abdominal type. In connection with these cases—and I should like you to pay special attention to this—we not only used mesenteric glands, but we used lesions at a distance and obtained the same results. When we examined any lesions at some slight distance from the mesenteric glands, we took not only the mesenteric glands, but anything we encountered in the immediate neighborhood which could be associated with these, and might not be associated with tuberculosis in any other parts of the body. You will understand, therefore, that we feel we have considerable evidence on this point. We have separated the bacillus of the bovine type from the human. We have had, in addition to those cases, 40 other cases of different kinds. I mention them in order that the opposite side may be estimated. We do not look upon these as of a virulent type; although, in calves, the bacillus gave a generalized progressive tuberculosis. I cannot give the particulars of the cases of tuberculosis of the cervical glands. We had eight mesenteric cases, ten in the lungs or bronchial glands, one case of tuberculosis of the kidney, one of tuberculosis of the testis, and nine cases of tuberculosis of the bones and joints. Our experience teaches that we cannot neglect this form of tuberculosis.

In connection with the prevalence of the disease, we have come to the conclusion that the bovine infections form a definite, and, therefore, important class of cases. No one for a moment can say that they are as important as

tuberculosis of the lung. But Professor Koch has pointed out that he considered the solution of this question so important that he is going to give his attention for some time to come toward solving it; that he is going to work to find out whether the bovine type of bacillus has anything to do with tuberculosis of the lung. We are delighted to hear that, because we know if he does undertake this work we will get some results. I cannot help believing that if Professor Koch had had the special experience in our country that we have had, he would, this morning, have taken a somewhat different view as to the importance of this general question. I would ask him, in view of the fact that these results vary so; in view of the fact that we have these differences of opinion as to the portal of entrance; in view of the fact that we are all making an effort to eliminate tuberculosis not only from the human race, but from animals also, how we can get rid of this disease? We are glad to know that he agrees with us, that we cannot get rid of it unless we get rid of it in cattle, and I would ask whether it is not worth while combining, until these points are settled, on some definite legislation, or, at any rate, not discouraging legislation which will help us to get rid of tuberculosis, not only in the form of phthisis of man, but also in the bovines. We know from experience that the amount of bovine tuberculosis will go on at an increasingly rapid rate unless we can adopt measures to curtail it.

In view of this great difference of opinion, and in view of the fact that Professor Koch is going to work on this subject,one cannot express very positive conviction at this time; but I hope that those of us who believe in the infectivity of bovine tuberculosis will consider it far preferable that we should do something that will certainly not harm the human family, rather than leave something undone which may allow harm to fall upon man.

Dr. A. Calmette: The requirements of Professor Koch are too stringent to allow definite solution of this question. The experiments made of infecting the aërial route of animals by inhalation of infected dust indicate well-known types of pulmonary infection, whether the bovine or the human bacillus be used as the infecting agent. However, in my opinion infection by the digestive route is by far the most important and most frequent. I admit, with many observers, that the bovine bacillus infects the mesenteric glands, for the reason that it has been taken from these glands, cultures made, and found to be the bovine bacillus. However, retention of the bovine bacillus in the mesenteric glands of young children or animals is of rare occurrence. Ordinarily such bacilli penetrate further into the organism and, becoming localized in pulmonary organs, by reason of their development, undergo a change in their morphological and biological characteristics and can assume the human type. This transformation, like those of different microörganisms in different animals, is brought about by prolonged sojourn in each species of animals, the bovine bacillus in chronic tuberculosis of lungs in man being

transformed into the human type, and frequently this infection has occurred in the mesenteric glands of children, thus permitting of finding the bovine tubercle bacillus there. The hog is equally susceptible to infection by the bovine type of bacillus or by that of the human type, and inasmuch as polymorphism is so well established in bacteriology, why should it be denied a place in the consideration of the tubercle bacillus?

Prof. Tendeloo: I have examined more than 1200 bodies for the existence of tuberculous foci anywhere in the body, and I have come to the conclusion that primary mesenteric tuberculosis is exceedingly rare. A great deal depends on the method of examination that is adopted, especially the examination of the lymphatic apparatus, particularly the lymph-glands in the lung. Unless the lung is carefully examined, according to the method I will presently describe, small tuberculous foci frequently escape detection. As a preliminary step, I always palpate the whole surface of the lung very carefully for the sensation of small caseating foci, or even of small cavities, imparted to the fingers, which is much more reliable than purely visual macroscopical evidence. After this is done, the lungs are cut with the usual two incisions, and after the pieces are again examined by palpation the whole lung is cut into small pieces and each portion carefully examined. In this way one will be surprised very frequently to find small tuberculous areas that would otherwise surely have escaped detection. If all the cases in which small foci found in the lungs are ruled out as doubtful in regard to a primary mesenteric infection, not to say probably secondary, then only a small number of cases of distinctly primary intestinal tuberculosis will be found.

I want to say a few words in regard to the claim advanced by Professor Calmette, that (bovine) tubercle bacilli may remain in the mesenteric glands without producing any local changes, and may then wander on to the lungs beyond, producing tuberculous lesions in these organs. I do not believe that this is possible. My main argument against this conception is the experiments of Cornet, which, peculiar to say, are not quoted as often as they should be, especially by those who have only made a few animal experiments as compared with the more than 3000 animal experiments that Cornet undertook. Other researches have confirmed these results. This work is not appreciated enough and is frequently unduly criticized by those least competent to do so. Cornet established the point beyond peradventure that wherever tubercle bacilli are introduced into the body, they either produce a strictly localized tuberculosis, or the tuberculosis involves the regional lymph-glands surrounding the area of infection. It makes no difference into what part of the body the tubercle bacilli are introduced, into the paw, the tail, or the intestinal tract, apart from intravascular inoculation. On the basis of these experiments, it is exceedingly difficult to understand how the organism of bovine tuberculosis should remain in the

mesenteric glands without producing any changes in these tissues, and then cause a tuberculosis in remote organs. The experiments of Calmette, it seems to me, do not sufficiently support his hypothesis. So far as they are clear, the results of post-mortem examination on human bodies wholly agree with the experimental results of Cornet.

Prof. J. Fibiger (Copenhagen): I still maintain that, according to the statements of the Gesundheitsamt, the English Commission, and of Jensen and myself, there is a considerable number of cases of bovine infection in children, especially in intestinal and cervical tuberculosis occurring in children. Opinions vary greatly in regard to the frequency of primary intestinal tuberculosis, but the tendency seems to be more and more toward discovering that these cases are much more frequent than they were formerly believed to be. Dr. Koch has quoted a number of pathological anatomists, and I will refer to the same authorities, referring chiefly to the results they have published in the last few years, whereas Professor Koch refers to their figures at an earlier period. [Professor Fibiger then gave many statistical data, referring to the contributions of Baginski, Hansemann, Benda, Orth, the English statistics of Kingsford, the statistics of Nebelthan, Lubarsch, Harbitz and his own cases, most of them showing a marked increase in the number of cases of primary intestinal tuberculosis occurring in children and reported within the last few years.]

It is quite apparent that there is in this direction a great diversity of opinion, and just how to explain the different figures is difficult. It is possible that differences in the methods of nutrition in different localities can be held responsible, in some places the milk being boiled, in others not, etc. There is no doubt in my mind, if I may repeat what I said before, that primary intestinal tuberculosis in children is a frequent disease. According to the summary of the figures published in the last few years from some hospitals in Kiel, Berlin, and Copenhagen, nearly every sixth or seventh child that is examined post mortem in these hospitals has primary mesenteric tuberculosis. If, now, every sixth child is affected in this way of all children examined, and if about a third of these cases are due to infection with the bovine bacillus, which I assume is probable, then about every eighteenth child that is examined on the autopsy table is affected with primary bovine intestinal tuberculosis; in other words, about 5 per cent. of all the children that come to autopsy. Professor Koch claims that the number of cases is small. If 5 per cent. of all dead children is not a big figure, what is a big figure?

Prof. Koch: Notwithstanding, I am not convinced. The result, so far ascertained, is that some pathological anatomists say that the figures are high and others that they are low. I am of opinion that the cases of primary mesenteric tuberculosis are rare, as also results from the considerable amount of information tendered just now by Professor Tendeloo. The question is

not, how many cases of primary intestinal tuberculosis are found? but, how many cases thereof are due to the tubercle bacillus of the bovine type? I refer to the statistics published by Gaffky, who in the course of the last two years examined 300 children that had died in the hospital of Baginsky, whom Mr. Fibiger refers to as having gradually brought out higher figures than formerly. Among the cases mentioned in the above statistics there were 53 deaths from tuberculosis, while 4 cases were doubtful; among those 53 cases there was not a single case of bovine tuberculosis, the patients having all been victims to human tuberculosis. Should this special difference perhaps be explained by supposing that there is less bovine tuberculosis in Berlin than in Copenhagen? This question must for the present remain undecided.

As regards the view expressed by Calmette, I have expected long since that somebody would put forward the argument that the bacilli change their character on the way from the mesentery to the lungs. But this, gentlemen, is a mere hypothesis, supported by nothing. On the contrary, everything we know at present on this subject speaks against this hypothesis; for it is a proved fact that the bovine tubercle bacillus keeps its character for a very long time. I have repeatedly found virulent bovine tubercle bacilli in old, healed-up, strictly localized, and partly calcified glands where these bacilli must have remained capable of life for a very long time. I have likewise had occasion repeatedly to examine typical wart-like swellings on the hands of workmen employed in the slaughter of tuberculous cattle. Even where such nodules on the fingers of the patients had existed for years, bacilli of the unmistakable bovine type could be isolated from them.

Considering the great confusion which apparently exists with regard to the whole problem in question, I would urgently warn against inferences from a hypothesis which is absolutely unsupported."

Theobald Smith: I wish to say a few words in regard to the passage of tubercle bacilli through the digestive tract into the lungs without being stopped in the mesenteric lymph-nodes. The evidence we have on this problem is based, first, on observations in the spontaneous disease; and, second, on experiment. In two species, swine and cattle, the spontaneous disease throws much light on this hypothesis. In swine we find that infection occurs almost exclusively through the digestive tract from the milk of cattle. The bacilli produce characteristic lesions in the regional lymph-nodes of the throat and the intestinal tract. Lung disease is quite frequent in pigs, but only in the form of miliary or disseminated tuberculosis. This indicates that the tubercle bacilli have been held back and have multiplied in the regional lymph-nodes and have reached the blood in a later stage from these nodes. There is no indication that the bacilli pass through the mesenteric nodes without lodging and producing primary disease there. Otherwise we should find only one or at most a few foci in the lungs and no lesions of the lymph-nodes of the mes-

entery. Fifteen years ago I made a long series of autopsies on cattle which had been tested with tuberculin, and many of which were in an early stage of the disease, in which the throat glands or the mesenteric or the thoracic glands or all three were involved, with intact organs. The conclusion which I reached at that time without bias or preconceived theory was that in practically all cases the tubercle bacilli would pass the mucous membranes and the alveoli of the lungs and lodge in the nearest lymph-nodes. There could even be observed a close relation between certain regions of the lungs and certain nodes. In later stages, when the lungs themselves were involved, certain nodes would be found heavily infected from certain definite regions. In cattle and pigs the evidence is thus very demonstrative that the bacilli are held back in the nearest lymph-nodes and that they do not pass directly through into the lungs. Finally, in cattle, the aërogenic infection is plainly demonstrated by the fact that the tubercles are confined to the dust-and-pigment-bearing lymph-nodes and to the dust-bearing zone thereof, and are not found in those nodes at the apex of the thorax which are free from dust and pigment unless the pleura or the cervical lymph-nodes are diseased. To the experimental evidence that feeding bacilli leads to the prompt infection of the lungs there are a number of objections or criticisms to record. These are aimed at the wide departure of the experiments from conditions obtaining in nature. Objections may be raised against—(1) the feeding of very large numbers of tubercle bacilli; (2) the use of bacilli, which, through artificial cultivations, have been changed as regards their relation to the invaded tissues; (3) the employment of the dog, which species stands in an uncertain relation to human or bovine tuberculosis; and (4) the killing of the animals soon after the feeding before the bacilli have had time to become anchored or fixed in the mesenteric nodes. I believe that the death agony which these experimental animals pass through soon after the feeding would tend to tear away from their temporary location in the lymph-nodes the bacilli which would remain there in the natural disease.

Prof. J. G. Adami (Montreal): We have now heard the opinions of workers in the various countries regarding the existence of infection by bacilli of the bovine type in man. We now know each other's views, and further discussion of the subject is not going to help us. But there is, I think, a matter that may be brought forward, and I wish to propound this question to His Excellency, Professor Koch: In his address before the Congress on Wednesday afternoon he stated emphatically that he confined himself to practical rather than to theoretical matters, and promised that during the next two or three years he would devote himself to the study of the incidence of the bacilli of the human or bovine type in cases of pulmonary consumption. Granted he does this, and suppose at the end of two or three years he finds—as for myself, I am fairly sure that he will find— that practically all cases of pulmonary

phthisis in men are due to bacilli of the human type, I would ask the question: What practical use is there in the investigation and in this delay? For at the end of the period we shall still be confronted with the problem of the eradication of tuberculosis in cattle, and that because, as he has admitted here and in London, a certain proportion of cases of the disease in man, though not of the pulmonary type, are due to the bovine bacillus. It seems to me, Mr. Chairman, rather unfortunate that both here and in London Professor Koch did not take up the other point which he has emphasized, namely, that so far not a single case is known in which the human type of bacillus has been found in the bovine organism under natural conditions, and, experimentally, only when we modify the conditions and use mixed cultures. Here, as I pointed out two years before Professor Koch's London pronouncement, is a matter that is eminently practical; for if this be admitted, then it is possible to eradicate bovine tuberculosis, even when we take no adequate steps to eradicate the human type in man. Granted that human and bovine cases coexist in a locality, the human type will not, under ordinary conditions, give the disease to cattle. Why not take up a line of work the result of which must be of immediate utility, rather than one which must, when concluded, leave us at most where we started?

Prof. Koch: I would again call attention to the fact that human tuberculosis is the principal point of attack, because eleven-twelfths of the patients perish through this type of the infection. I admit that bovine infection can occasionally occur, and I desire not to be understood as disregarding the endeavors to extirpate bovine tuberculosis, as far as these endeavors are dictated by agricultural and economic reasons. But I mean that it would be wrong to give to these proposals the leading place in front of the efforts to combat human tuberculosis.

Prof. Fibiger: Professor Koch has claimed that a great many of my figures especially apply to cases that were selected. This I deny. They were not selected. The results of Gaffky, to which Professor Koch refers, are not completed, nor have they to my knowledge been published. I can refer, so far as the other point is concerned, to the publications of Kleine, who reports two cases of hand infection in which the bovine bacillus was found.

Prof. Koch: I object to the interpretation of this latter finding, as it is evidently not conclusive in any respect; for we might be dealing here with cases of infection by human bacilli, as we frequently find them, in the shape of primary lesions, with pathological anatomists. In that case, such a finding differs very much from the cases mentioned by myself, where very virulent bovine tubercle bacilli were found in primary tuberculous lesions after many years.

The Chairman: It does not seem to me that we are very far apart. We have human and bovine tuberculosis, both of which are of great importance.

There is no question but that the vast majority of cases of human tuberculosis are due to human bacilli. There is a small proportion which are due to either the human or bovine bacillus. The only difference of opinion seems to be with regard to the question as to how large a percentage of that residuum is due to human infection or is due to bovine infection, and the question comes up: Is it possible to arrive at any kind of conclusion in a resolution which will put in form the feelings of the members of this conference in regard to this question? I think that is what should be considered in the few minutes left at our disposal.

Dr. Flick: I wish to inform this conference that a rule has been adopted by the central committee of the Congress that no resolutions can be considered which bear on a scientific problem. That would not preclude this conference from adopting a resolution for its own purpose, but I do not believe that such a resolution could be presented to the Congress itself.

Prof. Koch: Gentlemen, we are dealing here with a purely scientific subject, and the questions proposed cannot be settled by any resolution. We are speaking of objective facts and not of subjective views. I for my part most earnestly refuse to join in any resolution on this subject.

Prof. Woodhead: I look at this matter from a practical point of view. While we cannot settle these scientific questions definitely, as Professor Koch has pointed out, still we all agree that there are certain definite practical data we have at our command, and some resolution might be drawn up dealing with this purely from scientific aspects. The question which Professor Koch has pointed out is of minor importance when we come to deal with this more practical question.

Dr. Eastwood (London) was of opinion that a resolution ought to be passed and afterward placed before the Congress, in the closure meeting, on the following three practical questions: (1) Is the danger from the tubercle bacillus of the bovine type so slight for human health that it may practically be disregarded? (2) Does the consumption of milk containing bovine tubercle bacilli cause an increase of morbidity or mortality in children? (3) Is the institution of a supply of milk free from bovine tubercle bacilli a means that can efficiently assist the combat against human tuberculosis?

Prof. Koch: We have not at all discussed this subject; how can resolutions of purely practical importance be brought about in this meeting on things which we have not discussed to-day? I repeat I shall abstain from any resolution.

Dr. Pearson seconded the motion of Eastwood, and pointed out that, according to the general impression, Koch has estimated (in 1901, in London) the transmissibility of bovine tuberculosis to man so low that measures against bovine tuberculosis would be without importance to the public health. If, as Fibiger has explained from the statistics of Baginsky, the

cases of primary intestinal tuberculosis have considerably increased in Berlin since then, the question would have to be asked whether any neglect of precautionary measures in connection with the consumption of milk has occurred in consequence of the London statement.

A lengthy discussion ensued, in which Messrs. Flick, Smith, Ravenel, Arloing, and Eastwood took part, on the question whether and how the results of the conference are to be brought before the public.

Several orators pointed out the necessity to publish some account of the session. Finally, it was proposed to place the shorthand minutes before the public.

Prof. Koch: I have not the slightest objection to the publication of an exact report of this meeting. Why should I object to the statement that I recognize the transmissibility of bovine tuberculosis to man? I have never denied it. I propose, therefore, that a report shall be published, after the shorthand notes have been seen and signed by each speaker, but the report is only to be a mere reproduction of the spoken word, of the facts stated and of the opinions expressed, and is in no way to take the shape of any resolution, especially not on any questions which we have not discussed.

This arrangement proved acceptable, and after its adoption the meeting adjourned.

SECTION VII.

Tuberculosis in Animals and Its Relations to Man (*Continued*).

FIFTH SESSION.

Thursday, October 1, 1908.

THE DIAGNOSIS OF TUBERCULOSIS IN ANIMALS.

Section VII of the International Congress on Tuberculosis was called to order by the President, Dr. Leonard Pearson, at half-past nine o'clock, on Thursday morning, October 1, 1908.

THE INFECTION OF SWINE FROM TUBERCULOUS CATTLE.

By Dr. A. W. Bitting,
Purdue University, Indiana.

After the announcement made by some of the western newspapers that the stock from certain localities, particularly in Iowa and Wisconsin, would not be purchased by the packers because of the high percentage of loss in both hogs and cattle due to tuberculosis, an inquiry was started to determine whether such infected areas existed in Indiana. It was believed that it would be better to determine such areas ourselves rather than have the packer point them out and advertise them far and wide. The creamery men were appealed to, to inform us when hogs would be sent to market and to permit their tagging so that they might be identified on slaughter and inspection. This was declined.

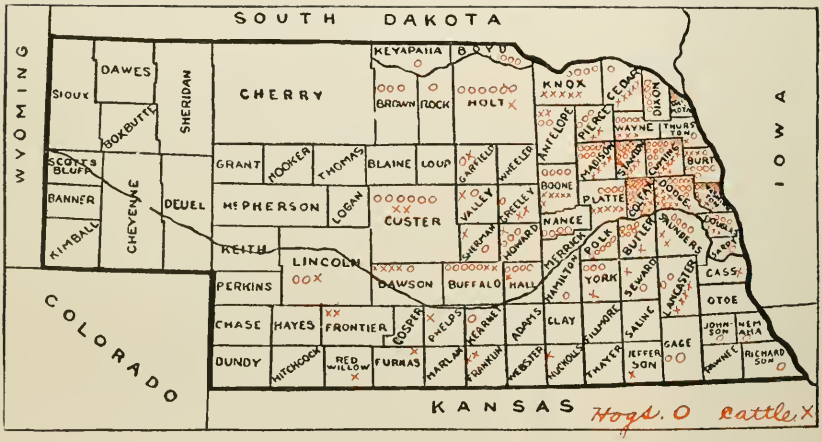
The Bureau of Animal Industry, through its local inspectors, has frequently notified us of the origin of certain tuberculous cattle, and these have been traced to the farms and inspection made of the herd.

During the past three years the local inspectors of the Bureau have reported the presence of any extensive outbreak of tuberculosis occurring in

hogs, and these have been traced to their origin, with the result of finding herds not previously suspected of having any tuberculous stock. Some of these have shown from 20 to 70 per cent. of infected cattle, and upon post-mortem as much as 33 per cent. would fail to pass on inspection. This has been true of pure-bred herds as well as of purely commercial dairy herds. With one exception, every important find of tuberculosis in the past three years has had attention attracted to it by the hogs coming from the premises.

The point which I desire to make is that, as far as may be practicable, a record should be kept in local inspection of the origin of all tuberculous hogs and furnished as a basis for the investigation of the condition of other stock upon the farm. This is not practicable in the large packing centers, but the Bureau has supervision over many small concerns in the smaller cities where such detailed information can be obtained.

The further work—that which I had expected to report upon, the experiments with hogs of different ages at two months, four months, six months, and eight months, to the susceptibility to tuberculosis from milk and excrement of tuberculous cattle—has been brought to an untimely end by an intercurrent disease, only seventy unsatisfactory animals of more than two hundred remaining to be examined.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DAKOTA
PIERCE
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THURSTON
SCOTTS BLUFF
BANNER
KIMBALL
CHEYENNE
DEUEL
GRANT
HOOKER
THOMAS
BLAINE
LOUP
GARFIELD
WHEELER
ANTELOPE
MADISON
STANTON
CUMING
BURT
McPHERSON
LOGAN
CUSTER
VALLEY
GREELEY
BOONE
PLATTE
COLFAX
DODGE
WASHINGTON
NANCE
KEITH
LINCOLN
SHERMAN
HOWARD
MERRICK
POLK
BUTLER
SAUNDERS
DOUGLAS
SARPY
PERKINS
DAWSON
BUFFALO
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YORK
SEWARD
LANCASTER
CASS
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CHASE
HAYES
FRONTIER
GOSPER
PHELPS
KEARNEY
ADAMS
CLAY
FILLMORE
SALINE
GAGE
JOHNSON
NEMAHA
DUNDY
HITCHCOCK
RED WILLOW
FURNAS
HARLAN
FRANKLIN
WEBSTER
NUCKOLLS
THAYER
JEFFERSON
PAWNEE
RICHARDSON

TUBERCULOUS HOGS AN INDICATION OF TUBERCULOUS CATTLE.

By Dr. A. T. Peters,
Department of Animal Pathology, University of Nebraska.

In presenting before this Congress the subject of "Tuberculous Hogs an Indication of Tuberculous Cattle," I wish to discuss principally the work carried on in Nebraska from May 1, 1907, to May 1, 1908. During the winter of 1907, when the legislature was in session, a resolution and appropriation for $1000 was passed for the Department of Animal Pathology to investigate tuberculosis among swine in our State. Prior to this time there had been nothing done on account of lack of funds. Our State Veterinary Department has only a meager appropriation, which barely covers the expenses of police work. For this reason it could not take up in detail the work of tuberculosis.

After the appropriation became available, our department immediately began to study the question of tuberculosis. We made arrangements with the Bureau of Animal Industry whereby we secured the names of owners who had shipped live-stock to the South Omaha market and who had part of their animals condemned for tuberculosis. After we received the names we tried to visit their farms to ascertain the conditions existing on these farms. It was important for us to become familiar with the kind of live-stock these farmers owned, the number of cattle and hogs on the place, the way they were fed, and whether, previous to our visit, they had any knowledge of their stock having tuberculosis. The government reported 281 farms as sending tuberculous stock. These 281 farms were located in fifty-five counties. Of these fifty-five counties, forty-seven were for swine tuberculosis and forty-one for tuberculosis in cattle. In thirty-three of these counties tuberculosis was reported in both cattle and hogs.

It is interesting to note that tuberculosis both among cattle and among hogs has been confined largely to one center in our State. This was indeed very surprising to us. Certain groups of counties are very much more affected with tuberculosis than others. It has also been found that when large shipments, especially of hogs, come from these counties, the percentage of condemnations is very large, running, sometimes, more than 3 per cent. When the percentage of condemnations for any given day has been very

large, an examination of the records showed that the counties known to be greatly affected with tuberculosis in swine had supplied the greater percentage of that day's killing. This was tested repeatedly when we would receive information from the government inspector that the condemnations were unusually numerous. This proves the assertion made by Dr. Burton Rogers several years ago, when he undertook to tag the 3430 hogs before the farmers unloaded them from their wagons. These tagged hogs were always killed separately. In this way he was able to trace back to the owner every tuberculous hog. He states that out of about 600 different hog-raisers bringing hogs to this one market, thirty-nine brought in all the tuberculous hogs. Our work in Nebraska for the last year in coöperation with the government in trying to trace the source of tuberculous animals is giving every evidence that Dr. Rogers's statement is true that infection comes from a small area, and that if the State was so provided with funds and facilities and a definite knowledge of where the infection existed that it could purchase and slaughter these animals, and thereby clean up infected areas, it would materially aid in stamping out tuberculosis in a short time. I wish to mention here that not only is it necessary for the State officers to be provided with ample funds to carry on this work, but I find that it is also necessary to have the people well educated in the fundamental principles of tuberculosis, and that the owners of live-stock should be thoroughly conversant with the dangers of this disease, that they should know how the disease spreads, the way to prevent it, and that it is an economical proposition to them to study the importance of tuberculosis, and that tuberculosis among hogs is far more treacherous than hog cholera, which only visits the farms once in many years, as proved by statistics. Tuberculosis remains on the premises permanently, and if he does not do anything to eradicate this disease, he will eventually have to go out of business. For this reason it is important that the methods in our State work should be thoroughly revised, so that not only large appropriations shall be granted, but that provisions shall be made to thoroughly educate the farmers and stockmen as to the dangers of this disease. This education should be one that would not scare or frighten the owner so that he would feel that the literature he was receiving was an exaggeration, thereby, instead of promoting the cause, making him an enemy who would favor antituberculosis legislation. I have been watching the progress that is being made in other States regarding this important subject, and the more I have studied the question, the more I have become convinced that when the stockman is thoroughly familiarized with the issue, and given plenty of time to think over the question, he is a very good man to work with, and would favor reasonable legislation. Knowing this fact, I started the work in our State by organizing a reading club. This reading club is largely composed of farmers and stockmen throughout the State. Ninety per cent. of

the members make stock-raising their principal occupation. These men were interested in the reading club, and the only requirement made was that after a certain period they had to return question blanks, properly filled out, before they could secure new literature. Lack of funds prevented us from printing literature, but the government and the experiment stations, having a large number of pamphlets that are well adapted for this work, were applied to and sufficient copies secured. These were then gone over and questions prepared. These questions were shortly sent to the members of the clubs, who filled out and returned the reply blanks to the office. After the blanks had been returned, another pamphlet was sent to them. Not only have we used the members just for the reading club, but we have secured a number of them to do missionary work in their own locality and secure new members. Many of the members have urged stockmen and dairymen in their community to have their herds tested by our Department or by the local veterinarian. In this way much good has been accomplished. We also feel that through this reading club we are securing a large number of people who will be willing to give accurate information to our various stock associations and to the members of our legislature if it becomes necessary to pass a suitable law for the eradication of tuberculosis from the State. Largely through the reading club and through coöperation of the Bureau of Animal Industry we have been able to test 42 herds of cattle, with a total number of 2543 head. Out of this number, 93 head reacted; 46 of these were killed, and a post-mortem examination revealed tuberculosis. The remaining 47 head were disputed, and these were retained by the owners, under proper quarantine restrictions, to be tested again. This shows a percentage of 3.65 of cattle that reacted to the tuberculin test. We have records of 386 head of cattle that were tested by the owners themselves, formerly agricultural students. These comprised 16 herds. They were only small herds. The students did the work themselves, and copies of the temperature sheets were sent to us for verification. Out of this number there were 29 head, or 7.51 per cent., condemned by our department, 18 of which have been reported to us as having been killed and found to be tubercular. I mention this to show that the tests were made quite accurately by the students themselves. Of the remaining 11 head, the accuracy of the test was disputed, as the owners made the test just before gestation. Assurance was given that these animals would be tested again, and if they reacted, they would be slaughtered.

Out of the 281 farms reported to us, 222 were visited by representatives of our department and the conditions carefully studied. We were surprised to find that a large percentage of the farms, especially on places where tuberculosis existed among the hogs, were receiving separator milk. We noticed, however, that a larger percentage than was anticipated had never

received dairy products, and that by no means is skim-milk entirely accountable for the infection of tuberculosis in hogs. Two herds in particular where there was a large condemnation had not been receiving dairy products, but that tuberculosis existed among the cattle was discovered later through the tuberculin test and the post-mortem examinations. Previous to destroying these animals, samples of the fecal matter were secured, and examinations of the same revealed tubercle bacilli. The method given in Bulletin No. 99 of the United States Department of Agriculture was used for making these examinations.

I have become more and more a believer that hogs become affected to a large extent through fecal matter, because of the habit of breeders in allowing their hogs to follow cattle. There is no question but what this practice gives occasion for a large percentage of the condemnations among the hogs. Through this matter the lymphatic system becomes infected, and glandular tuberculosis, which is by far the most frequent, is caused by hogs being compelled to follow and gain their sustenance through the offal of diseased cattle. We are making careful examinations along this line to verify more conclusively this statement. But enough evidence is at hand at this time to warrant the statement that if our system of feeding hogs were changed, the number of tuberculous hogs would be greatly reduced. There is no question but what we have overlooked the great source of infection, that is, the fecal matter, and on account of this oversight the States that are supplying a large percentage of the hogs have suffered such a rapid increase in the disease.

Coöperation at the packing centers between the government and the State is practical, fruitful of results, and important, and should be cultivated and perfected. The government is in a position to aid the State authorities in a most wonderful way if the State authorities are only willing to accept the assistance. It is through the government inspectors that the State can locate the infected centers; and then if these places are visited by representatives and the conditions noted, the representatives can in the larger percentage of cases persuade the owners to clean up their herds. It is a pleasure to me to report that 66 of the 281 farms reported to us have cleaned up their herds in one way or the other, either by using the tuberculin test or by sending the animals to the abattoirs subject to inspection; and that these people are assisting the department at this time. They are very desirous of not having diseased stock on their premises. It is a remarkable fact that 92 per cent. of the 281 farmers reported that previous to our visit they had no knowledge of any disease in their herd, and were very much surprised when they were informed that animals had been destroyed. This is all the more emphasized where hogs had been condemned by the inspectors of the government itself. One of the embarrassing features that we had to contend with in visiting these farms was to inform the owner that the government had con-

demned animals of his shipment, for it is a fact that repeatedly some of the best-looking animals, and the ones that topped the markets at our abattoirs, have been condemned. It has been a surprise to the owner when we would visit him a week later and tell him that four, five, or six of his animals had been condemned, and it is a very difficult matter to explain to the stockman how fat animals in the prime of condition and topping the market could be condemned by the government inspectors. And then comes the task of convincing this man that the government official really did find the disease in the carcass, and that it would be well for him to clean up the remainder of his herd. Here again comes in the value of resorting to literature and correspondence. I will admit that we could not at the first time convince an owner that the remainder of his herd was in danger, but by supplying him with literature we convinced him that it is possible for animals in the best condition to be diseased. These men have become thoroughly interested and are working for better conditions. In going over the map of our State which shows the affected areas I must again call attention to the fact that has been observed by Dr. Rogers, that the infection is located in one place, and for this information I believe that it would be well for our government to make regulations by which the animals could be identified when they reached the killing floors. Much as I have investigated this matter and spoken to the proper authorities about a tagging and identification system of this kind, they have thought it not feasible, but I am sure that the time will come when such tagging will become necessary, for if the government or States will continue to follow the source of infection and find the same, as we have done in our State, it will show that tagging is the only feasible way of eradicating this disease, and that it is much cheaper than any other method. At the present time it does not seem popular, but I believe that by proper agitation, bringing the matter before the public, the opposition would soon be greatly diminished.

The work that is in progress at this time is a continued study of the source of infection and the promotion of our reading club throughout the entire State, so that the people will request to have their herds tested instead of being compelled to have it done. The importance of this campaign of education is shown by the fact that if we had assistance enough we could test practically as many herds in one month as we tested in the twelve months last year. It is hoped that aid will be given to the State authorities to meet these demands by the creation of sanitary boards similar to the ones existing in Pennsylvania and Minnesota. From our reports and from the statistics at hand it seems as though the affection has not gained any considerable foothold in the state of Nebraska, and that if suitable measures were to be enacted at an early date, the disease could be prevented from spreading.

The Bang system has been advocated in our State, and also a modification of this system made by Dr. Johnson, but none of these have been found to be practical on our farms, for it seems to be very expensive to maintain this system. Several of the best breeders in our State have been investigating the question, and no doubt experiments along this line will be taken up.

Vaccination against this disease has not been recommended, on account of a lack of funds; and, furthermore, as our department has considered it still in its experimental stage, we for this reason did not care to use this treatment, as it may prove a hindrance to the eradication of tuberculosis. The department is watching with great interest the experiments conducted by others along these lines.

The tuberculin test has proved very satisfactory, and through this agency we have a means for detecting tuberculosis in a herd, and we can very readily clean up a herd. This work encountered a great deal of opposition, for the reason that the State had no compensation to offer for these cattle. It is interesting to know that in every instance where tuberculosis had been found on the post-mortem floors and the remaining herd visited and tested with tuberculin, evidence of the disease was found in the herd.

In conclusion, I wish to say that by giving our State proper legislation, and by a continual and plentiful dissemination of proper literature to the stockmen and the farmers, thereby enlisting their hearty coöperation instead of their antagonism, and by the splendid aid of the agricultural press, progress in stamping out tuberculosis will be achieved.

The following is a list of the bulletins of the Bureau of Animal Industry and the experiment stations that have been secured for the reading club in our State:

Circular 118 of the U S. Dept. of Agr.: "The Unsuspected but Dangerously Tuberculous Cow."
Bulletin 92 of the Ia. Expt. Sta.: "Tuberculosis in Swine."
Bulletin 277 of the N. Y. Expt. Sta.: "The Bang Method of Controlling Tuberculosis, with an Illustration of its Apparatus."
Bulletin 44 of the U. S. Dept. of Agr.: "Infectiveness of Milk of Cows which have Reacted to the Tuberculin Test."
Bulletin 38 of the U. S. Dept. of Agr.: "Tuberculosis of the Food-producing Animals."
Paper by Dr. G. A. Johnson: "The Disposition of Tuberculous Cattle."
Circular 79 of the U. S. Dept. of Agr.: "The Tuberculin Test for Tuberculosis."
Bulletin 78 of the N. H. Expt. Sta.: "Bovine Tuberculosis."
Bulletin No. 77 of the N. Dak. Expt. Sta.: "Bovine Tuberculosis."
Bulletin 126 of the Wis. Experiment Sta.: "Two Ways of Treating Tuberculosis in Herds."
Circular 70 of the U. S. Dept. of Agr.: "Tuberculosis of Cattle."
Bulletin 108 of the Ohio Expt. Sta.: "Bovine Tuberculosis."

THE TUBERCULIN TEST AN EFFICIENT AGENT FOR THE DETECTION OF BOVINE TUBERCULOSIS.

By Geo. B. Jobson,
Veterinarian, Franklin, Penna.

Whatever difference of opinion may exist relative to the question of the transmissibility of tuberculosis from bovines to man, there can, however, be none relative to the injurious effect which bovine tuberculosis, from its contagious nature, has on the cattle trade of infected countries. The danger of transmitting the disease to healthy herds, or into localities free from infection, and its prevalence, particularly in dairy districts, are of themselves grave conditions affecting the welfare of the live-stock interests of the State; the question, therefore, of the most efficient method whereby it can be controlled is one necessarily demanding the earnest and thoughtful consideration of the national or State authorities in charge of this department of control work.

In its economic aspect, we have in bovine tuberculosis a scourge the ravages of which are productive of serious financial loss to the agricultural resources of the State, on account of deaths and depreciation in the value of tubercular cattle; and, on the other hand, an ever-present possible danger to the community from the consumption of their flesh or milk. We have had other bovine plagues in America, such as contagious foot-and-mouth disease and contagious pleuropneumonia, which were a menace to the cattle trade of this country. The campaign against the former disease was short, sharp, and decisive; that against the latter occupied five years, and was finally eradicated with an expenditure by the Federal government of $1,500,000. Although stockmen of that period looked on the means used for its suppression as a doubtful and expensive experiment, the result accomplished in freeing this country from this destructive bovine plague fully justified the expenditure. Pleuropneumonia, however, was only dangerous to cattle, whereas in tuberculosis we have to contend with a much more dangerous disease, the consensus of opinion of the best authorities being that tuberculosis may be transmitted to man through the ingestion of bovine bacilli in the flesh or milk of tubercular cattle, the difference existing between the morphological characters of the human and bovine bacilli being merely one of environment. Insidious in its approach, and slowly progressive, it is a far more subtle and treacherous foe, usually giving no visible indications of its presence until is has attained a firm foothold in the herd, and scattered broadcast the germs of

infection; and it is only in the advanced stage of the disease, when the animals are about useless for the butcher or the dairy, that it can be detected on physical examination and without the aid of the tuberculin test. In the light of recent research by the Bureau of Animal Industry we see that tubercular cattle giving no visible evidence of having tuberculosis, yet may become infective to those which are healthy, through contamination of their food by the feces of diseased animals. In filthy stables and dairies where the milk is not drawn from the cows and handled in a cleanly and sanitary manner it is frequently contaminated by bovine feces, and in untested herds the consumer has thus no assurance that his milk does not contain tubercular bacilli.

Although it is not claimed that the tuberculin test is absolutely infallible as a diagnostic agent, yet every veterinarian employed in the work of control knows the difficulty of detecting bovine tuberculosis by physical examination, unless in cattle extensively diseased, and those who have had the largest experience in this work admit that there is no other method whereby tuberculosis can be so readily and accurately diagnosed as by the tuberculin test. It does not always follow that because cattle are in good condition and look healthy there is no tuberculosis in the herd. Even after a test has been made and previous to slaughter and autopsies being held on reacting animals, the owner has been known to doubt the accuracy of the diagnosis. In a herd of fifty head tested by the writer some few years ago, twenty-two reacted. On autopsy, several of the reacting animals were found to have extensive tubercular lesions. One fine young Jersey cow, a family pet, had tuberculosis of the udder, her milk being used by the owner's family. These cattle were principally registered Holsteins and Jerseys, were in the pink of condition, and the most improved hygienic methods were adopted in the management of the herd. The owner, an experienced breeder, had no suspicion that tuberculosis existed in the stable until two fat cattle were sold to the butcher, which on being slaughtered were found to have extensive tubercular lesions. On a retest of the herd being made eight months later, only one animal reacted, the post mortem showing slight tubercular lesions in the post-pharyngeal glands. The herd did not again come under our personal observation.

The case of the herd belonging to the State Institution for the Feeble-Minded at Polk, Venango County, Pennsylvania, illustrates the value of the tuberculin test in eradicating tuberculosis from an infected herd. This herd, composed principally of registered Holsteins, numbering seventy head, was tested on August 30, 1903. All the registered cattle had previously been tested. Nine untested grade cows were purchased on January 29, 1903, near Conneautville, Crawford County, Pennsylvania. When tested with the other members of the herd, five of thse cows reacted. They were at once separated from the healthy animals and quarantined in a stable half a mile distant from the dairy stable and afterward slaughtered. All had well-developed tuber-

cular lesions. In one cow they were extensive. The premises were thoroughly disinfected and whitewashed, the stalls occupied by the infected cows kept vacant for a a considerable time, and before being occupied were again disinfected. On March 30, 1904, about eight months later, a retest of the whole herd, numbering eighty head, resulted in no reactions. On January 21, 1907, nearly three years afterward, the whole herd, now consisting of one hundred and thirty head, was again tested, with the same result—no reactions.

This particular instance illustrates how quickly tuberculosis can be detected and eliminated from an infected herd by using the tuberculin test. We will now give an illustration of the protection afforded by tuberculin in preventing the introduction of tuberculosis into a healthy herd. The Argeon dairy herd, located in the vicinity of Franklin, Pennsylvania, is composed partly of Red Polled cattle, excellent individuals, and partly of grade Jerseys —in all, about fifty head. The proprietor, an experienced and cautious breeder, bought some few years ago, at public auction, for himself and two other parties, two Shorthorns, two Jerseys, and three Holsteins, all apparently in good healthy condition. As a precautionary measure, however, before mixing the seven cows with the regular dairy herd, the owner put them in quarantine in a separate stable and had them tested. The two Shorthorns and two of the Holsteins reacted. The reacting Holsteins were appraised and slaughtered. The two Shorthorns, one being a heifer and the other a cow in her prime, were in such splendid condition that the owner did not believe they were diseased, and rather than have them destroyed, isolated them on a farm where no other cattle were kept. The heifer was accidentally killed, and the cow, after calving, commenced to run down in condition, and on being slaughtered about nine months after the test, was found to have extensive tubercular lesions in both lungs. Had these tuberculous cattle been at once mixed with the healthy herd, we can realize what would have been the result. The herd has been again tested since this occurrence and found to be free from tuberculosis.

Among the several reasons why the tuberculin test, systematically applied for a few times, and at proper intervals, fails to eradicate tuberculosis, is the very inefficient manner in which the stables are disinfected by the ordinary farmer, and the failure to at once separate and place the reacting animals in quarantine.

No doubt there are instances in which tuberculin fails to detect the existence of tuberculosis, or there are doubtful reactions in which it is difficult to determine whether the inspector has got a true tubercular reaction, or whether the rise in temperatures proceeds from some other cause. In many cases these failures are largely attributable to carelessness in neglecting to have the animals kept under exactly the same normal conditions for a day or

two preceding, and until the completion of the test. In advanced tuberculosis, where the system is saturated with tubercular toxins, there is sometimes little, if any, reaction. Quite frequently, however, the temperatures of these animals are a degree or so above normal previous to the injection of tuberculin. Also when, for fraudulent purposes, cattle have been treated with repeated injections of tuberculin, they will cease to react.

Advanced pregnancy, in most instances, does not apparently interfere with the accuracy of the test. The temperature of cows in this condition, especially heifers, may in some cases run a little higher than normal, but the injection of tuberculin, if they are free from tuberculosis, will not cause any appreciable elevation of temperature. Neither, as a rule, will the fact of a cow being in heat, if shut up during the period of estrum, have any adverse influence on the test; nevertheless, in all doubtful cases, after a proper interval, a retest ought to be made. The temperatures of very young calves are frequently erratic, and it is much the safer plan, when suspected of having tuberculosis, to hold them in quarantine until they are at least six months old, previous to testing. Cattle exposed to extreme cold previous to taking their initial temperatures, and kept in a warm stable during the remainder of the test, are not likely to give accurate results. Their initial temperatures in some cases range from 98° F. to 100° F. Under the same conditions, were no tuberculin used, there would be a perfectly natural reaction following the low temperatures of the preceding day.

Those opposed to the tuberculin test point to the fact that cattle tested prior to purchase have, on a retest, reacted. Such cattle have either not been honestly tested—for there are a few unscrupulous men in the veterinary as well as in other professions—or they may have come out of a tuberculous herd, and, the infection not having advanced further than the incubative stage, they were, when tested, not yet susceptible to the action of tuberculin. Unless absolutely sure that the herd from which the cattle are purchased is free from tuberculosis, it is advisable to quarantine them for two months or so, and retest them before they are mixed with the herd.

While the test is an efficient medium for diagnosing the existence of tuberculosis, the amount of reaction does not indicate the extent of the lesions. Young animals in good condition, when tuberculous, are very susceptible to the action of tuberculin, and consequently their reactions are usually higher than in old cows. On slaughtering these young animals giving high reactions the lesions are often slight, and confined, in the majority of instances, to the mediastinal or bronchial lymphatic glands. On this account parties have sought to discredit the test on account of the limited character of the lesions, ignoring the fact that it is merely a question of time when these slightly diseased animals may, in time, become foci of infection to the healthy members of the herd.

Among the several charges which have been made against the use of tuberculin, one is that its use will communicate tuberculosis to the animals operated on. This charge is entirely without foundation. If, as is now generally conceded, tuberculosis is a bacterial disease, transmitted to animals by the introduction of the living bacilli into the animal organism, it is utterly impossible that the injection of tuberculin can communicate tuberculosis to cattle, the cultures from which it is made being sterilized by heat and afterward filtered to remove the dead bacilli. The test of the Polk herd, to which the writer has previously referred, shows that its use in this case had no such injurious result. The first test and autopsies proved that five animals had tuberculosis. On a retest, about eight months afterward, no reactions; and on a third test, after nearly three years, still no reactions, nor any visible symptoms of tuberculosis. Surely, here was ample opportunity to test the validity of the assertion that tubercular infection would follow the use of tuberculin.

Another charge is that the test has produced abortion in pregnant cows. We have tested somewhere near about four thousand head of cattle, this number being composed principally of milch-cows, some of them in advanced pregnancy, and we have failed to hear of a single well-authenticated case which could be traced to this cause; neither has any complaint come from the owners of any of the tested herds that abortion has followed its use.

In Pennsylvania the meat hygiene service provides a convenient method whereby reacting animals can be disposed of with safety to the public health and the owner indemnified for his condemned carcasses. Reacting cattle which have been tested by authority of, or reported to, the State Live-stock Sanitary Board can be slaughtered at a slaughter-house and inspected by an agent of the Board, under the rules governing the meat hygiene service. Condemned carcasses are appraised and compensation allowed the owner according to a scale fixing their value, thereby protecting both the public health and recompensing him for his loss. Previous to the organization of the Pennsylvania State Live-stock Sanitary Board there was no systematized method of controlling tuberculosis or disposing of diseased carcasses, and we can safely assume that carcasses which are now condemned under inspection would formerly, in many instances, be exposed for sale. Should the owner of reacting cattle prefer the Bang method for their disposal, he can do so by keeping them quarantined in a stable separate from the healthy cows, taking away the calves when dropped, and sterilizing or pasteurizing the milk previous to its use for any purpose whatever. Visibly diseased cows, with advanced tuberculosis, are destroyed and the owners indemnified for their loss. The busy American farmer, however, with his high-priced labor, does not take kindly to the Bang system of disposing of reacting cattle. There is too much trouble and expense in running two separate herds, and it is a difficult task getting the help to give the extra care and attention necessary in feeding,

watering, and milking two separate herds. The sterilization or pasteurization of the milk from the reacting cows also requires care, and it is a continual source of worry and annoyance keeping the tubercular animals apart from those which are healthy. Unless, therefore, the reacting animals are exceptionally valuable, the owners usually prefer having them slaughtered.

It may be asked what results have been achieved in Pennsylvania by the State Live-stock Sanitary Board in controlling bovine tuberculosis by the use of the tuberculin test. Taking as a basis the writer's own experience in this work, from its inception in 1896 to the present time, during which period he has tested somewhere about four thousand head of cattle: of the first 400 tested, 22 per cent. reacted; of the last 1000 tested, 6 per cent. reacted. The majority of the herds were suspected of being infected with tuberculosis, while a few others were tested either for sale purposes or in order to advertise the milk-supply to be from tuberculin-tested cows. The counties in Pennsylvania covered by the tests were Crawford, Venango, Butler, Clarion, Forest, and Warren. These figures do not refer to, nor are they estimates of, the percentage of tubercular to healthy cattle in the counties named. They give the relative percentage of reacting cattle in herds tested, and which in the majority of instances were suspected of being infected with tuberculosis. In the more recent tests the decided diminution of reactions would indicate that bovine tuberculosis in that section of Pennsylvania is now more fully under control, and if the experience of the other agents of the State Live-stock Sanitary Board agrees with that of the writer, it is reasonable to suppose that in these later years there has been a decided decrease in the percentage of tubercular cattle over the entire State.

Las Pruebas de Tuberculina son un Agente Eficiente para Averiguar la Tuberculosis Bovina.—(Jobson.)

Prevalencia de la tuberculosis bovina en los distritos dedicados á las industria de leche y crianza de ganado. Su aspecto económica, pues la tuberculosis bovina produce serias pérdidas financieras en los intereses de la crianza en los lugares infestados. Peligro en el consumo de la carne y la leche de ganado tuberculoso. Pérfida en sus ataques y de progreso lento, gana firme terreno en el rebano antes de que pueda descubrirse su presencia. Dificultades del diagnóstico por examen físico, á ménos que sea en casos avanzados. Los veterinarios que han tenido grande experiencia en el trabajo de contrarrestar la tuberculosis, admiten que las pruebas de tuberculina son el más seguro método para diagnosticar la enfermedad. Casos citados para ilustrar su eficiencia. El fracaso es el resultado del descuido y la inexperiencia. Causas que invalidan la exactitud de la prueba. El método de Pennsylvania de disponer de ganado reactivo. Disminución del percentage de reacción en los últimos años en rebaños probados en Pennsylvania.

La Réaction de la Tuberculine; un Agent efficient pour découvrir la Tuberculose bovine.—(Jobson.)

Prédominance de la tuberculose bovine dans les endroits occupés par l'industrie laitière et l'élevage des bestiaux. Son aspect économique, la tuberculose bovine produisant une perte financière sérieuse dans les régions infectées. Le danger provenant de la consommation de la viande et du lait de bestiaux tuberculeux. La tuberculose, arrivant insidieusement et faisant des progrès lents, s'établit de pied ferme dans le troupeau avant que sa présence puisse être découverte. Difficulté du diagnostic par l'examen physique, jusqu'à la phase avancée de la maladie. Les vétérinaires avec beaucoup d'expérience admettent que la tuberculine nous offre la meilleure méthode diagnostique.—Citations de cas pour illustrer l'efficacité de la tuberculine. La non-réussite est le résultat du manque de soin et d'expérience. Causes qui annullent l'efficacité de la réaction. La méthode en usage en Pennsylvanie pour disposer du bétail qui réagit contre la tuberculine. Diminution, pendant les derniéres années, du pourcentage des réactions dans les troupeaux de la Pennsylvanie, chez lesquels la tuberculine a été employée.

Die Tuberkulinprobe ein wirksames Mittel für die Entdeckung der Rindertuberkulose.—(Jobson.)

Das Vorherrschen von Rindertuberkulose in Gegenden mit Milchprodukten und Viehzucht. Der ökonomische Standpunkt; Rindertuberkulose kann sehr schweren finanziellen Verlust den Viehzuchtinteressen infizierter Länder beibringen. Gefahr von dem Genuss von Fleisch und Milch tuberkulöser Rinder. Schleichend in ihrer Annäherung und langsam fortschreitend, gewinnt sie eine starke Stütze in der Herde, bevor ihre Anwesenheit entdeckt werden kann. Schwierigkeit der Diagnose durch die physikalische Untersuchung ausser in vorgeschrittenen Fällen. Diejenigen Tierärzte, die eine grosse Erfahrung in dem Werke der Kontrolle von Rindertuberkulose gehabt haben, geben zu, dass die Tuberkulinprobe die sicherste Methode der Diagnose dieser Krankheit ist. Fälle angeführt, welche die Wirkung illustrieren. Misslingen ist das Resultat von Sorglosigkeit und Unerfahrenheit. Ursachen, welche die Genauigkeit der Probe abschwächen. Die Pennsylvania-Methode in Bezug auf die Verfügung der reagierenden Rinder. Abnahme in letzten Jahren des Prozentsatzes von Reaktionen in geprüften Herden in Pennsylvania.

Die Häufigkeit der Respirationen gab ebenfalls wertvolle Auskunft. Von den anderen Momenten konnte man keine positiven Schlüsse ziehen.

Die älteren Kinder gaben etwas bessere Resultate als die jüngeren, und die in dem Sanatorium behandelten waren besser daran als die ambulant oder im Spital behandelten Kinder.

Die Resultate in den Kindern waren besser als in den Erwachsenen, wenn die Krankheit nicht so ausgedehnt war, aber nicht so gut in den vorgeschrittenen Fällen.

DISCUSSION.

Prof. Arloing: Tuberculin is an almost absolutely reliable agent for the diagnosis of tuberculosis. The reaction caused by tuberculin must be regarded as indicating positive lesions of tuberculosis. It does not sometimes produce a reaction in tuberculous animals, the causes of which are the very extensive lesions in the animal. In cases where animals fail to show any lesions after giving a reaction to the tuberculin, it does not indicate necessarily the absence of the disease in the animal. We have a wrong impression of tuberculosis. The presence of the disease is usually only conceived by the macroscopical lesions, but there is also a microscopical tuberculosis which has been and can be demonstrated by animal inoculations. Moussu, Arloing, and Heyman's experiments prove that tubercle bacilli placed in a capsule and introduced into the body of an animal will give a reaction to tuberculin. If an animal is injected with tuberculosis and is killed fourteen days after artificial infection, it will show no macroscopical lesions, yet such an animal would react to the tuberculin test before slaughter, thus showing that while the disease exists in such an animal, there are no visible lesions present in any of the organs. It is therefore necessary to recognize the microscopical cases of tuberculosis, and all cases which react to the tuberculin test and which do not show lesions may be accepted as affected with the microscopical form of the disease. The tuberculin test is absolutely reliable in all reacting cases, and animals which react should be considered as being affected with tuberculosis.

TUBERCULOSIS:

A REPORT OF THE RESULTS OF THE CONTINUED INJECTIONS OF TUBERCULIN UPON TUBERCULAR CATTLE.

By S. B. Nelson,

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The treatment of tuberculosis in the human family by the subcutaneous injection of tuberculin has received very considerable attention by the medical profession during the past decade. As to the value of this form of treatment there appears to be a wide difference of opinion among physicians. Some have given up the use of tuberculin entirely, believing it to be of negative value; while others claim for it that, with the better knowledge obtained through its increased use, the results are constantly better and more encouraging.

It was through the observance of this work in the human family that the veterinary department of this station planned a series of experiments to study the effect of subcutaneous injections of tuberculin into cattle under the conditions under which they are generally kept; that is, a fairly well-kept stable in the winter-time, being outdoors a part of the day-time, and a run to pasture during the summer months, being kept in the barnyard at night during this time.

The first series of experiments were carried on during the year 1900, and the second series during 1903–07. The first experiments were carried on with Jim, a four-year-old Jersey bull, and Lora, a three-year-old grade Holstein-Jersey heifer. The object of these experiments was to observe the action on these animals of continued injections of tuberculin. The action of the injection was to be observed through the temperature of the animals, their general appearance, and a study of the post-mortem lesions.

These two animals were tested with the other animals in the herd March 1, 1900, giving the following reactions:

March 1st and 2d.		A. M.	P. M.		A. M.			P. M.				
		10	2	10	7.30	9	11	1	3	5	7	10
Lora 2 c.c.	10 P. M.	102°	101.4°	101.4°	103°	105°	105°	104.1°	102.2°	102.2°	102.3°	101.3°
Jim .2 c.c.	10 P. M.	100.1°	100.3°	101°	101°	102°	103.3°	105.4°	106°	103.4°	103°	102.1°

They were retested April 9th and 10th, May 4th and 5th, and May 21st and 22d.

April 9th and 10th.		P. M.			A. M.				P. M.			
		2	7	10	6	8	10	12	2	4	6	8
Lora 2 c.c.	10 P. M.	102°	102°	102.1°	101°	102°	102°	102°	102°	101.2°	102°	101.4°
Jim .2 c.c.	10 P. M.	101.3°	101.2°	100.1°	102°	101.4°	102°	102°	102°	101.3°	101.3°	101.2°

May 4th and 5th		A. M.		P. M.		A. M.			P. M.		
		8	12	5	10	7	9	11	1	4	8
Lora ....3 c.c.	10 P. M.	101°	101.3°	103°	102.4°	102°	101.6°	101.4°	101.4°	102.2°	101.4°
Jim .....3 c.c.	10 P. M.	100°	100.8°	101.6°	101.5°	100.6°	101.6°	100.3°	101.2°	101.2°	101.2°

May 21st and 22d.		P. M.			A. M.			P. M.		
		12	5	10	8	10	12	2	4	6
Lora .....3 c.c.	10 P. M.	101.4°	102.4°	102°	99.6°	101.2°	102.8°	102.2°	102°	101.8°
Jim .....3 c.c.	10 P. M.	101.2°	101.2°	100.8°	98.6°	100.8°	100.8°	100.8°	100.8°	100.6°

The original test of March 1st and 2d was considered a typical tuberculin test, while the three tests following were not so considered, even with the injection of 3 c.c. in the last two. It was nevertheless decided to continue the injections of constantly increasing doses of tuberculin as previously indicated. In both animals the temperature was taken three times daily during the experiment.

Lora was given the following injections:

June 10th	2 c.c.	tuberculin
" 17th	3 c.c.	"
" 23d	4 c.c.	"
" 27th	5 c.c.	"
July 5th	6 c.c.	"
" 10th	7 c.c.	"
" 14th	8 c.c.	"
" 18th	9 c.c.	"

A study of the temperature chart shows an observable difference between the morning and evening temperatures, that of the evening averaging 0.6 degree higher than the morning one. The average temperature on the day after each injection is generally lower than the corresponding average of the day before the injection. There is very little difference between the average temperatures of the three days immediately preceding and following the injections.

Lora was killed August 29, 1900. She was in fairly good flesh when killed. Post-mortem examination showed the mediastinal glands filled with calcified tubercular nodules. The caudal extremity of the left lung was filled with a number of small caseated tubercles. No new foci of infection were found.

Jim received injections as follows:

June 10th	2 c.c.	tuberculin
" 17th	3 c.c.	"
" 23d	4 c.c.	"
" 30th	5 c.c.	"
July 7th	6 c.c.	"
" 14th	7 c.c.	"

In Jim's case the evening temperature was 0.4 degree higher than the morning temperature; 0.2 degree less difference than was found in Lora. The general temperature of Jim ran about 0.5 degree lower than it did in Lora.

There is no constant difference between the average temperature of the day before and the day after the injection. The same holds true of the average temperature of the three days immediately preceding and following the injection. The average temperature of the week after the last injection is the same as that of the week after the first injection. Jim was killed the same day as Lora. Post-mortem lesions found were a few small caseated miliary tubercles on the left pleural surface and one on the pericardium; the animal was otherwise healthy.

Without doubt on March 1st, when these two animals were first tested, they were affected with tuberculosis, possibly in a very slight degree, and the lesions were primary in character at that time. Probably after this test the lesions began to become caseous, the acute form of the disease passing into a more or less chronic form, a possible recovery gradually taking place, and therefore at the following three tests a typical reaction was not obtained. Because of this probable recovery and absence of the tubercle bacillus the repeated injections of the constantly increased doses of tuberculin failed to give any appreciable rise of temperature at any time during the experiment.

The next series of experiments were planned along more extensive lines. The animals experimented upon consisted of eight cows and one bull. They were all registered Jerseys, with the exception of one cow, which was a grade Jersey.

The series included four experiments, as follows:

Experiment 1.—Including cows Nos. 52 and 53 and bull No. 48. To test the injection of 2 c.c. of tuberculin and doubling the doses monthly. The temperature to be taken every night and morning, with the exception of the day after the injection, when it is to be taken every two hours.

Experiment 2.—Including cows Nos. 49 and 51. To test weekly injections

of tuberculin, beginning with 2 c.c. and weekly adding 1 c.c. Temperatures to be taken the same as in Experiment 1.

Experiment 3.—Including cows Nos. 54 and 55. To test the injection of tuberculin, beginning with a weekly injection of 2 c.c., lessening the period one day between each succeeding injection until it becomes daily, then increasing the dose 0.5 c.c. daily. The temperature to be taken each night and morning, with the exception of once weekly, when it is to be taken every two hours.

Experiment 4.—Including cows Nos. 50 and 56. To test the injections of tuberculin, beginning with 0.5 c.c., continuing the injections whenever the temperature was normal, but increasing or decreasing each succeeding dose so as not to increase the temperature; if possible, to prevent it.

These animals had been tested with tuberculin and reacted, and the owner, not wishing to be troubled with keeping them separated from his other cattle, decided to send them to the experiment station for experimental purposes. They were retested December 9 and 10, 1903, at which time they all gave very typical reactions. They were placed in the experiments December 12, 1903.

Experiment No. 1. Monthly Doubled Injections.

In experiment No. 1 cow No. 53 received the first injection, of 4. c.c., January 14, 1904, and the last, of 8 c.c., February 13th. She was destroyed March 5th.

To both injections she gave decided reactions. For several weeks prior to this animal's death she had been gradually growing weaker. She showed quite marked symptoms of enteritis. Great dullness, accompanied at times with exhibitions of pain; pulse weak; respirations rapid and catching; appetite, however, fairly good, but not regular. On the 28th of February she, with the others, had been turned out to pasture. The weather became rainy and cold, and this animal was so chilled and exhausted that she could not return to the stable that evening, but was hauled in early the following morning.

March 5th she was so weak that it was deemed best to destroy her. Post-mortem held immediately.

Lungs normal except a few lesions of lobular pneumonia.

In the intestines were found several tubercular ulcers, some of them penetrating the jejunum.

About ten of the mesenteric lymph-glands were tubercular and quite calcareous. The lymph-glands in general showed evidence of great emaciation, being deeply pigmented and watery in the center.

The peritoneum on the left side was normal, but on the right side it showed marked chronic peritonitis. The membrane was 4 cm. thick in

many places, and liquefactive necrosis was in progress. The peritoneal cavity contained about 4 liters of foul-smelling liquid.

Cow No. 52 received her first injection, of 4 c.c., on January 14, 1904, and the last, of 2048 c.c., on November 25, 1904. She died April 10, 1905, being found dead in her stanchion after she had eaten a feed of green grass.

She was greatly bloated, and her death was in all probability due to tympanites. She was in fairly good condition and had a thrifty appearance. The lungs contained a few old tubercular foci. The post-pharyngeal, bronchial, anterior and posterior mediastinal glands were tubercular and were passing into the stage of calcification. All other tissues and glands were normal.

The bull No. 48 received tuberculin injections the same as cow No. 52, but because of his vicious temper it was deemed advisable not to try to take his temperature, as was done with the cows. There is therefore no temperature record in his case.

This animal was in good condition when he was put into the experiment. He had absolutely no physical symptoms of tuberculosis. He was given a shed stall and paddock to run in and was well fed during the entire experiment.

In October, 1904, he began to show external symptoms, such as lameness, swelling of the shoulder-joints, rough, staring coat, occasional diarrhea. From this time on he failed rather rapidly, and when he was killed, September 19, 1905, he was unable to get to his feet when down. Post-mortem lesions.

In general ante-mortem appearance the animal was very emaciated, the skin was rough, and the coat stary. Post-pharyngeal lymphatics were greatly enlarged, tubercular, and calcareous. The left axillary and prescapular glands were tuberculous, as were the small supernumerary glands of the anterior mediastinum. The portal lymphatic was tuberculous. Several of the small gastric and nearly the entire chain of mesenteric glands were also tubercular.

The bronchial and mediastinal glands were extensively diseased.

Nearly all parts of the lungs contained tubercular foci. Neither the pleura nor the pericardium was involved.

In the liver were a number of quite large tuberculous nodules. The intestines contained ulcers, evidently tubercular in character.

One nodule was found on the left kidney.

No. 52 gave reaction to the following injections:

Jan. 14, 1904,	4 c.c.	102.7°	105.3°	105.4°	105.1°	105.5°
Feb. 13, "	8 c.c.	102.3°	104°	104.2°	103.7°	102.9°
Mar. 13, "	16 c.c.	103.5°	103°	102.8°	102.4°	102.1°
Apr. 14, "	32 c.c.	101.4°	102.1°	102.2°	102°	101.6°

The April record would hardly be considered a reaction, and none occurred after that date.

It is rather interesting to note that during the early part of the experiment the morning temperature of both Nos. 52 and 53 was higher than the evening one. In No. 52 this was true during the first six months, or up to the time she had received 32 c.c. of tuberculin at that injection. From that time until the last injection, of 2048 c.c., the temperature in the evening averaged higher than in the morning. During the last four months her temperature ran more irregularly. It would sometimes go to 103° to 104° for a day and then drop to 99° to 100°.

The evidence in these three experiments tends to show that in Nos. 53 and 48 the results were negative, while in No. 52 the injection may possibly have had beneficial action.

Experiment No. 2. Weekly Injections Adding 1 c.c.

In experiment No. 2 cow No. 49 received her first injection, of 2 c.c., on January 3, 1904, and her last injection, of 16 c.c., April 17th of the same year.

She gave a reaction of 103° to every injection. She was very poorly nourished, hair rough and staring, mucous membranes anemic, pulse and respirations rapid.

Post-mortem lesions found were:

Anterior middle lobe of right lung completely solidified and filled with tubercles varying in size from 1 to 5 cm. Lower two-thirds of posterior lobe also filled with tubercles. In the left lung was found the same condition as in the right, except to a less degree. The tubercular foci were nearly all calcareous.

The udder contained tubercular foci that had undergone calcification.

On the surface of the omasum there was one tubercle about 1 cm. in diameter, filled with calcareous material.

The external inguinal, superior mammary, mesenteric, portal, and bronchial glands were all affected, the latter being greatly enlarged and calcareous. The anterior and posterior mediastinal glands were also affected.

Cow No. 51 was always in good flesh and condition up to the time she was destroyed, July 8, 1907. A very careful examination gave no macroscopical evidence of any lesions of tuberculosis, which makes this case a very interesting one. The following preliminary tuberculin test was considered a characteristic one:

	A. M.				P. M.		
	6	8	10	12	4	6	10
Dec. 9, 1903	..	..	97.1°	98.4°	101.3°	..	101.6°
Dec. 10, 1903	100.5°	102°	103°	104.3°	104.5°	103.2°	..

From January 3, 1904, when she was injected 2 c.c. of tuberculin, until June 13, 1904, when the injection had been increased to 25 c.c., she gave rather irregular and indefinite temperature reactions. From June 13 to December 26, 1904, with the gradual increase in the injections to 48 c.c., her temperature at no time went above 102.8°, giving no reaction. From January 7, 1905, to January 1, 1907, when she received 150 c.c. of tuberculin, she gave quite characteristic reactions.

	A. M.			P. M.	
	8	10	12	2	4
Jan. 14, 1905, 51 c.c.	102.5°	103.7°	104.2°	104.1°	104.8°
Feb. 10, " 55 c.c.	100.2°	102.2°	103.3°	103.4°	102.6°
Feb. 25, " 57 c.c.	101.6°	102.7°	102.6°	105.6°	105°
Mar. 18, " 60 c.c.	101°	101.5°	102.8°	105°	105.7°
May 26, " 70 c.c.	101.3°	102.4°	102.8°	103.8°	103.6°

These, I think, are fair examples of how the weekly tests ran. Some ran higher and some lower than these. From January 1, 1907, to May 28, 1907, there was no reaction whatever to any of the injections.

It is probable that this cow had tuberculosis to a very slight extent when she was first tested, and recovered by June 13, 1904, to become reaffected by January, 1905, because of her confinement with the other tubercular cattle during the earlier winter months, and again recovering by January, 1907; and yet we were not able to find any traces of pathological lesions. Is it possible that the disease could exist to a sufficient extent to give the temperature reactions and yet not form the usual lesions because of the large amounts of tuberculin continually kept in the animal's body? or was the reaction an error the greater part of the time?

It seems most reasonable to believe that the animal subjected to continual exposure by being kept in the stable in close contact with the other extensively diseased animals was continually being infected, and the large doses of tuberculin prevented the development of the pathological lesions.

In this experiment with these two cows the temperature shows entirely opposite conditions as to the relation between the morning and evening temperatures. In No. 49 the morning temperature, with the exception of just a few mornings, exceeded the evening temperature. This is rather unusual in this disease. While in No. 51 there was marked exacerbation of the evening temperature.

The injection of the tuberculin as carried on in this experiment may have had therapeutic value in both of these animals. In No. 49 the lesions were to a marked extent calcified, showing that a strong recuperative force was present. In No. 51, if it was of value, it was probably prophylactic in character.

Experiment No. 3. Daily Injections.

In experiment No. 3 cows Nos. 54 and 55 received their first injections, of 2 c.c., on January 3, 1904, and the last one, of 48 c.c., on June 13, 1904.

No. 55 was killed June 15, 1904. She was so weak and emaciated that it was thought advisable to kill her. She had been suffering from diarrhea for about a month, which at times was so severe that the feces were smeared with coagulated blood.

Post-mortem lesions found immediately after death were that the lungs contained a few tubercular lesions; here and there on the pleura were a few pearly tubercles; the bronchial lymph-glands were greatly enlarged and contained calcareous nodules in large numbers; the posterior mediastinal gland was also much enlarged and extensively affected; the intestines showed enteritis, but no definite tubercular lesions; all other organs were apparently healthy.

Cow No. 54 was killed July 7, 1907. This animal was in a thrifty condition, as was evidenced by the flesh she was in and by the appearance of her coat. She was suffering from a slight leukorrhea due to local vaginitis.

Post-mortem lesions found were tubercular lungs, pleura, intestines, liver, and lymphatics. The anterior and inferior lobes of the right lung contained many tubercles, and the diaphragm was covered with quite a number of them over the affected part of the lung. The small intestines contained in their wall a number of calcified abscesses. The same was true of the liver, where there were fifteen or twenty calcified tubercles on its surface. All of the lymphatics had calcified tubercular lesions in them.

In both of these cows the temperature chart showed that from the beginning of the experiment to the time the injections were discontinued the temperatures ran very irregularly. There was no definite relation between the morning and evening temperatures.

During the first month of the experiment, that is, up to the date that 7 c.c. were injected, the weekly two-hour temperature record shows reaction to the injection. At no time after that is there any indication of any reaction, except that on June 4th, after the injection of 43.5 c.c., both animals showed a rise in temperature. From June 13, 1904, to May, 1907, No. 54 ran quite a regular weekly temperature—practically the normal temperature of a healthy cow.

In both of these cows the lesions were old and calcareous. No fresh centers of infection were found in either one of them, although in No. 55 the enteritis, diarrhea, and high temperature during the last three weeks might have indicated enteric tuberculosis.

The cessation of reaction seemed to show that the injections had had positive influence on the disease, or that the large daily injections had so filled the animal's body with tuberculin that reaction from the next injection

was impossible; but the additional evidence of the chronic lesions found would point toward the positive influence of the injections in this experiment.

Experiment No. 4. Small Fluctuating Injections.

Cow No. 50 was in very good flesh up to within three months before she died, July 21, 1905. This breakdown in condition began soon after she calved, March 9, 1905.

Post-mortem lesions: The lungs were extensively affected, showing many foci involving large areas. There were also countless numbers of miliary tubercles, indicating either that the old local lesions had given rise to generalized tuberculosis or that she had become reinfected. The indications are that it was from the former, as all the organs and glands, lungs, liver, spleen, diaphragm, mesentery, uterus, and udder, were all extensively affected, as well as all the lymphatic glands. The posterior mediastinal was about 25 cm. in length. This was one of the severest cases of generalized tuberculosis that has come under our observation.

Until in February, 1905, she did not give any appreciable reaction to the injection of small doses, but subsequent to this time, with double the amount of tuberculin, she would continually run to 104° to 106°. On April 11th she showed an evening temperature of 104.7°; this was the beginning of her very high evening temperatures. At first, from April 11th to May 11th, this high temperature only occurred weekly, but from May 11th to the day she died her evening temperature was constantly very high.

Cow No. 56 had for some little time been quite poor in flesh, and just before her death she was extremely emaciated.

Post-mortem: On the right side of the neck, between the skin and fascia, there was a small tubercular nodule. The lungs were extremely tubercular. They contained in some places broken-down areas with cavity formation containing broken-down tissue and pus. The entire chain of lymphatics was diseased. The small intestines, especially the ileum, contained tubercular ulcers. The liver, spleen, pleura, pericardium, and udder were apparently healthy.

This animal showed from the first of the experiment an increased evening temperature, but after May 10, 1905, she constantly presented an increasingly high evening temperature, although her morning temperatures were nearly always normal. During the last three days that she was alive her temperature was subnormal, at no time reaching 99°.

In this experiment of using small doses of tuberculin the original plan was slightly deviated from, in that toward the end of the experiment the dose of tuberculin injected was kept at 2 c.c. nearly all of the time, and each injection resulted in a rise of temperature, when the dose should have been so varied as to have prevented the rise of temperature, if possible.

In both of these animals the weekly injections of what is considered a normal dose of tuberculin constantly gave a typical reaction. The rise of temperature, however, began very soon after the injection, reaching its maximum in six to eight hours, instead of waiting six to eight hours before beginning to rise, and then not reaching its maximum before fourteen to eighteen hours.

In these advanced cases of tuberculosis small continued doses of tuberculin did not exhibit any positive therapeutic value.

Conclusions.

1. The injection into tubercular cattle of large monthly or small weekly doses of tuberculin does not have therapeutic value.
2. The injection of constantly increased daily or weekly doses of tuberculin does have therapeutic value.
3. The evening temperature is usually higher than the morning temperature in tubercular cows.
4. The oftener tuberculin injections are made into tubercular cattle, the sooner the temperature reaction begins and the sooner the zenith is reached.

Report sur les Résultats d'Injections continuelles de Tuberculine au Bétail tuberculeux.—(Nelson.)

Les présentes investigations s'étendent sur une période de plus de cinq ans. Dans un troupeau de bétail tuberculeux onze animaux typiques furent choisis; ils furent divisés en quatre groupes. On fit au premier groupe une injection de tuberculine chaque mois, en doublant la dose à chaque injection, jusqu'à ce que chaque animal eût reçu plus de deux litres à la fois.

On fit au second groupe une injection par semaine, en augmentant graduellement les doses, mais en restant à des doses relativement petites. Le troisième groupe reçut tous les jours des injections croissantes. Le quatrième reçut toutes les semaines de petites quantités changeantes selon le progrès de la maladie.

L'auteur conclut de ces expériences que de grandes doses mensuelles ou de petites doses hebdomadaires de tuberculine n'ont pas de valeur thérapeutique, tandis que l'injection de doses augmentant constamment tous les jours, ou toutes les semaines, semblent donner de bons résultats.

Il trouva que la température du soir des animaux ayant reçu l'injection était plus haute que la température du matin et que, plus souvent on fait les injections, plus tôt après l'injection la température commence à monter. L'auteur recommande, en conséquence, que, là où les animaux reçoivent les injections fréquemment, on les fasse de préférence le matin.

Bericht über die Resultate fortgesetzter Injektionen von Tuberkulin auf tuberkulöses Rindvieh.—(Nelson.)

Diese Forschungen über den möglichen therapeutischen Effekt von Tuberkulin-Injektionen auf tuberkulöses Rindvieh erstrecken sich auf eine Periode von fünf Jahren. Aus einer Herde von tuberkulösem Rindvieh waren elf typische Tiere ausgewählt worden. Sie waren in vier Gruppen eingeteilt worden.

Die erste hatte eine Injektion von Tuberkulin jeden Monat erhalten, wobei die Dosis einer jeden Injektion verdoppelt wurde, bis jedes Tier über zwei Quart Tuberkulin zur selben Zeit erhalten hatte. Die zweite Gruppe wurde einmal in der Woche mit nach und nach ansteigenden, aber verhältnismässig kleinen Dosen injiziert.

Die dritte hatte täglich grösser werdende Injektionen. Die vierte erhielt wöchentlich kleine fluctuierende Quantitäten, wie sie durch den Fortschritt der Krankheit indiziert waren.

Dr. Nelson zieht die Schlussfolgerung, dass grosse monatliche oder kleine wöchentliche Dosen von Tuberkulin keinen therapeutischen Wert haben, während die Injektion ständig anwachsender täglicher oder wöchentlicher Dosen dem Tier wohl zu tun scheint.

Er fand, dass die abendliche Temperatur injizierter Tiere für gewöhnlich höher war als die morgendliche, und dass je öfter die Injektionen gemacht werden, desto schneller nach der Injektion die Temperatursteigerung beginnt. Er empfiehlt daher, dass, wo die Tiere häufige Dosen erhalten, sie am Morgen injiziert werden.

DISCUSSION.

Dr. Connaway: With reference to Dr. Nelson's paper, I do not believe that his conclusions regarding the therapeutic value of tuberculin are justified, owing to the small number of animals used in his experiments. It seems that a positive conclusion should be based on more extensive work, to get a therapeutic value which can be put into practice. Moreover, I think that along with these experiments check animals should have been used, in order to see if other animals under similar conditions might not have shown calcifications. I have seen calcifications in calves not more than three or four months old which had been infected for only a few weeks. I believe Dr. Schroeder will bear me out in this statement.

Dr. Schroeder: I think it is very doubtful if we can tell the age of lesions. I have observed, however, calcified lesions in a case of congenital tuberculosis in a calf five days old.

Dr. Nelson: I intended to direct attention to these points, but not to attempt to make them positive conclusions.

Dr. Meyer: When this great triennial congress shall have adjourned, it will be found that its most important pronouncement will be, "educate the masses." However backward Louisiana may be in exhibits and public sanitation, she is at least a pioneer in insistence on this necessity. The whole scheme of the Louisiana system of hygienic education is based on two principles:

First: The necessity of instructing the masses in the cause and prevention of all contagious and infectious diseases, and especially of those common to man and domestic animals, like tuberculosis.

Second: The duty of the State to furnish this instruction; this duty is apparent not only from a humanitarian standpoint, not only because under free governments men have and claim an inalienable right to life, liberty, and the pursuit of happiness, these being inseparable from the "mens sana in corpore sano," but from an economic point of view, because it is cheaper to prevent than to cure or take charge of the human physical derelicts as they float on the waters of life, a menace to every other object they meet. This system had its inception in 1878, was tentatively tested in 1884, and shown to be practical in a popular institute of hygiene held in Apelousas in 1897, when for seventeen consecutive years the attention of a lay audience was held without a break in the continuity of interest, the subject discussed being tuberculosis, typhoid and yellow fever, variola, etc. This system correlates all educational factors—medical, veterinary, legal, commercial, industrial, editorial, and clerical, the latter the most important, on account of their wide range of influence. In practice we have found the illustrative lecture the most popular form of conveying the instruction, and by its use we converted a people wedded for a century to the fomites stelluric origin of yellow fever to the mosquito doctrine of transmission. No popular institute of hygiene will be a success without appropriate musical numbers to relieve the strain on the lay mind. The charter of our State Sanitary Association, chartered in 1897, besides providing for the education of public opinion on all health matters, also provides for "the restriction and prevention of tuberculosis and the founding of sanitaria for its hygienic-dietetic treatment" (sec. 6). The State Medical Society in 1894–05 adopted resolutions placing themselves in line; the Agricultural Department for ten years included hygiene of home and farm in the curriculum of their institutes. The State Legislatures of 1900 and 1902, by handsome majorities, passed a measure designed to put in operation a great scheme of hygienic education which was twice vetoed by the governor, who failed to grasp the humane and economic value of the measure.

SECTION VII.

Tuberculosis in Animals and its Relations to Man (*Continued*).

SIXTH SESSION.

Thursday Afternoon, October 1, 1908.

CONTINUING THE DISCUSSION OF THE DIAGNOSIS OF TUBERCULOSIS IN ANIMALS.

The Section was called to order by the President, Dr. Leonard Pearson, at half-past two o'clock.

RAPPORT DE COMMISSION DE L'OPHTALMO-REACTION.

RAPPORT PRÉSENTÉ AU NOM DE LA SOCIÉTÉ DE PATHOLOGIE COMPARÉE.

PAR LE DR. BAILLIART,
Paris.

Au mois de Décembre dernier, au nom de la Commission spéciale nommée par la Société de Pathologie Comparée, j'ai présenté dans mon rapport les conclusions que nous crûmes devoir adopter à la suite de l'étude qu'avait faite, après d'autres auteurs, deux de nos collégues MM. Jugeat et Morel, Vétérinaires Sanitaires de la Seine. Mais la question ne nous paraissant pas à ce moment définitivement tranchée, nous avons invité nos confrères à poursuivre leurs recherches. Nous résumerons ici, dans ce nouveau rapport, à la suite de leurs premiers travaux les résultats de leurs secondes expériences.

Les premières observations de M. Jugeat ont porté sur 63 animaux appartenant à six exploitations différentes; chaque sujet a été éprouvé successivement par l'ophtalmo-réaction puis par la tuberculination ordinaire.

M. Jugeat divise les réactions obtenues du côté de l'oeil en trois classes:

Les *réactions légères* qui se traduisent seulement par un peu d'injection et d'oedème de la conjonctive.

Les *réactions moyennes* dans les quelles on voit se dessiner des arborisations vasculaires sur le globe de l'oeil; en même temps on constate un peu d'oedème et d'injection du corps clignotant et un peu de larmoiement.

Les *réactions fortes* enfin, où tous les caractères précédents s'exagèrent avec apparition de muco-pus dans le grand angle de l'oeil.

Les plus violentes de ces réactions ont d'ailleurs toujours paru à M. Jugeat, fugaces, sans aucune gravité.

Il est évident que de telles classifications ne présentent aucun caractère scientifique et que telles réactions classées par un observateur dans la première catégorie pourront être classées dans la 2 ème, ou pourront passer de la 2 ème dans la 3 ème ou inversement. Il y a là des difficultés d'interprétation très manifestes que M. Jugeat ne manque pas de signaler.

Dans l'établissement de sa statistique de succès ou d'insuccès, il a donc pris le parti de considérer comme négatifs tous les cas à réaction faible; une légère injection de la conjonctive peut, en effet, être produite par la simple irritation mécanique due à l'instillation du liquide. Il faut d'ailleurs reconnaître que les conjonctives oculaires et palpébrales sont normalement injectées chez bon nombre d'animaux.

Sur 63 animaux observés, M. Jugeat a obtenu 14 réactions fortes, 4 réactions moyennes, 14 réactions faibles et 31 réactions nulles. Ces réactions faibles, considérées au point de vue pratique, comme n'ayant point de valeur diagnostic, doivent être ajoutées aux 31 réactions nulles, ce qui nous donne, sur 63 animaux soumis à l'ophtalmo-réaction, 45 résultats négatifs contre 18 positifs.

Les 18 animaux ayant donné ce résultat positif à l'ophtalmo-réaction ont présenté une réaction nette à la tuberculination. Il y aurait donc à ce point de vue concordance parfaite entre les méthodes: tout bovin réagissant nettement à l'ophtalmo-réaction réagit à la tuberculination.

Voyons maintenant les résultats négatifs: 45 animaux n'ont pas réagi à l'ophtalmo-réaction, ou leur réaction a été si faible, que, pratiquement, M. Jugeat ne veut pas en tenir compte.

Sur ces 45 animaux ne réagissant pas à l'ophtalmo-réaction, 8 ont réagi nettement à la tuberculination: 37 n'ont pas réagi d'une façon plus que de l'autre.

Si nous groupons maintenant ces résultats, nous voyons que sur 63 expériences, il y a 55 fois accord entre les deux méthodes, et 8 fois seulement discordance (soit dans 13% des cas seulement) M. Jugeat arrive, en suivant la même méthode cependant à un pourcentage très différent d'insuccès, 28%. C'est que, considérant les réactions faibles comme très difficiles à

interpréter il les considère non seulement comme des insuccès, mais encore comme des cas de discordances, aussi bien lorsque la réaction thermique est positive que négative. Il m'a semblé très certain qu'il y avait là une erreur d'interprétation, et que si, de toute évidence, on pouvait tenir pour nulles les réactions faibles, on n'était nullement en droit de considérer comme discordants tous les cas où, quelle que fût la réaction à la tuberculination, la réaction oculaire était faible.

Dans la 2ème partie de sa communication, M. Jugeat envisage la question d'un autre point de vue. Plusieurs auteurs déjà, MM. Guerin et Lemaire, notamment avaient signalé que des sujets antérieurement soumis à l'ophtalmo-réaction, étant postérieurement tuberculinisés, présentaient du côté de l'oeil éprouvé une nouvelle reviviscence des symptômes oculaires, ou même leur apparition dans des cas où la simple ophtalmo-réaction avait été négative. Les résultats des expériences de M. Jugeat ont été très encourageants: apparition de réactions nettes chez des sujets qui, avant tuberculination, n'avaient pas réagi, transformation en réactions nettes, évidentes, de réactions primitivement faibles ou bâtardes.—Ces secondes expériences ont porté sur 30 animaux. Ces animaux ont d'abord été soumis à la simple ophtalmo-réaction, puis, huit jours après, à la tuberculination sans nouvelle instillation oculaire.

L'ophtalmo-réaction donnait comme résultats comparés avec les réactions thermiques ultérieurement observées après tuberculination:

20 concordances.

2 discordances,

8 cas douteux.

L'observation des yeux des mêmes animaux, après tuberculination, 8 jours après toute instillation de tuberculine fournissait des réactions telles que les résultats donnés cette fois étaient les suivants:

28 concordances,

2 cas douteux.

Pas un seul cas nettement discordant.

Dans une première série de travaux, M. Morel a expérimenté de son côté sur 78 vaches provenant de différentes vacheries de la banlieue parisienne. Comme M. Jugeat après instillation de tuberculine dans l'oeil il a, quelques heures après, procédé à la tuberculination. Alors que M. Jugeat employait de la tuberculine brute de l'Institut Pasteur, diluée à $\frac{1}{10}$, à $\frac{1}{20}$, ou $\frac{1}{50}$, soit dans l'eau bouillie, soit dans le sérum physiologique, M. Morel a employé d'abord la tuberculine brute diluée au $\frac{1}{30}$ ou au $\frac{1}{20}$ dans l'eau distillée, puis a employé la tuberculine médicale Pasteur.

Ce choix de la substance à instiller ne paraît pas inutile; il a semblé à M. Morel comme à d'autres auteurs que des réactions trop violentes pouvaient suivre l'instillation de solutions concentrées. Il rapporte notamment

que, se trouvant un jour dans une vacherie où il pouvait expérimenter, n'ayant pas le temps de se munir d'un compte-gouttes, il versa directement dans les yeux des animaux une partie d'un tube de tuberculine diluée au $\frac{1}{30}^{e}$. Il y eut une apparition d'ophtalmie très violente, avec muco pus, larmoiement, gonflement de l'oeil et des paupières, symptômes qui persistèrent une dizaine de jours. M. Morel mit sur le compte de cette "ophtalmie tuberculinique" des symptômes généraux que présentèrent les animaux atteints tels qu'inappétence, faiblesse et diminution de la sécrétion lactée.

Ne pourrait-on pas admettre aussi bien que les phénomènes généraux apparaissant chez des animaux soumis non seulement à l'oculo-réaction mais encore à la tuberculination, doivent être attribués à la réaction générale plutôt qu'à la réaction locale.

Les observations de M. Morel sont consignées en des tableaux si clairs et si précis, qu'il paraît inutile de les résumer: au bas de chaque table d'expérience il donne les résultats en accords et en désaccords.

Voyons donc sa récapitulation générale:

Sur 78 animaux soumis aux deux méthodes, 36 ont réagi, à l'oculo-réaction nettement. Les cas légers ont été classés comme douteux, et comme tels nous pensons qu'ils doivent être considérés comme négatifs. Il faut reconnaître, d'ailleurs que M. Morel n'a pas hésité à considérer comme douteux tous les cas où la réaction n'était pas très nette. Considérons donc dans l'étude des concordances et des discordances comme réactions nulles toutes les réactions douteuses. Sur les 36 vaches ayant réagi à l'oculo-réaction, 2 n'ont pas réagi à la tuberculination (ce premier résultat est en contradiction avec ceux des expériences de M. Jugeat). 42 ont réagi à la tuberculination, et sur ce groupe de 42 tuberculeuses d'après cette épreuve, 4 n'avaient pas réagi à l'ophtalmo-réaction.

Il y a eu 11 cas douteux (au point de vue de l'oculo-réaction).

Sur ces 11 animaux, 5 ont réagi à la tuberculination.

Comme discordances, nous trouvons donc (en considérant comme réactions nulles, les réactions douteuses, malgré tuberculination constatée), 9 animaux réagissant à la tuberculination sans réagir à l'ophtalmo-réaction et 2 ayant réagi à l'ophtalmo-réaction sans réagir à la tuberculination soit 11 discordances sur 67 accords; il y a eu entre les méthodes discordances dans 14% des cas. Ce chiffre de discordances est très sensiblement identique à celui que nous obtenions en analysant de la même façon les résultats de M. Jugeat (13%). M. Morel, cependant, donne une autre proportion 78% de concordances et 7% de discordances. Cela tient à ce qu'il néglige dans sa statistique les cas douteux, dont il est cependant impossible de ne pas tenir compte; comme je l'ai déjà dit, il me paraît absolument évident que les cas douteux doivent être pratiquement et théoriquement considérés comme des réactions négatives, et que nous devons cependant en tenir compte.

14% de discordances d'après les expressions de M. Morel, 13% d'après celles de M. Jugeat, on voit que l'écart n'est pas très grand entre les résultats obtenus par nos deux collègues. Tous les deux, comme la plupart de ceux qui ont étudié la question au point de vue vétérinaire, estiment que l'ophtalmo-réaction est une méthode infidèle, incapable de fournir une certitude ou même une présomption sérieuse. Le Professeur Vallée est bien loin de croire la méthode infaillible; il la considère comme "moins intéressante que la cuti-réaction, de recherche peut-être moins aisée, mais infiniment plus durable dans ses manifestations et moins favorable aux tentatives frauduleuses."

MM. Irr et Claude, à une des dernières Séances de la Société centrale de médicine vétérinaire rapportaient le résultat de leur expérimentation sur 57 bovins. Dans plusieurs cas, ils trouvèrent la méthode en désaccord avec l'épreuve de la tuberculine; tous les animaux cependant qui donnèrent une réaction oculaire donnèrent également une réaction à la tuberculination.

A la même séance, M. Lignieres rapportait le résultat de très intéressantes expériences: d'où il ressortait que si l'ophtalmo-réaction est souvent infidèle, en la combinant avec l'épreuve de la cuti ou de la dermo-réaction, on peut obtenir des résultats presque certains. M. Lignières emploie la tuberculine brute pure.

En médecine humaine, le nombre d'ophtalmo-réactions effectuées jusqu'à ce jour est considérable; on peut dire qu'il se chiffre par milliers. Les communications faites sur ce chapitre sont trop nombreuses pour que j'essaie de les résumer ici; je voudrais donner seulement quelques chiffres, résultats des plus récents travaux.

M. Comby a pratiqué l'ophtalmo-réaction sur plus de 300 enfants; il la considère comme un procédé infaillible pour diagnostiquer la tuberculose latente des enfants. Il emploie soit la tuberculine Calmette, soit la tuberculine Roux, à $\frac{1}{200}$e.

M. Lesné l'a étudié sur 150 enfants. Il déclare les résultats parfaits. La solution qu'il emploie est à $\frac{1}{500}$e. M. Letulle après une expérimentation sur 125 malades déclare que l'ophtalmo-réaction possède une grande valeur seméiologique dans la tuberculose pulmonaire de l'homme.

Au commencement de Juillet, M. Calmette et ses élèves avaient déjà 115 réactions personnelles; tous leurs sujets, enfants ou adultes, cliniquement tuberculeux avaient réagi. Il en a été de même pour certains malades atteints d'affections diverses chez qui la tuberculose n'était tout d'abord pas soupçonnée, mais qui, à un examen plus approfondi ont été trouvés porteurs de lésions suspectes.

MM. Dumarest et F. Arloing ont soumis à l'ophtalmo-réaction, à la tuberculine 41 tuberculeux pulmonaires provenant d'un sanatorium de la région lyonnaise. Sur ces 41 malades, 14 étaient au 1er degré de la tuber-

culose, 20 au 2e et 7 au 3e; les auteurs ont employé la tuberculine Vicario à $\frac{1}{100}$e. Sur les 41 cas, l'ophtalmo-réaction a été 27 fois positive, 5 fois négative et 9 fois douteuse. Contrairement à ce que la plupart des expérimentateurs ont jusqu'ici observé, ce sont les malades du ler et du second stade qui ont offert le plus grand nombre de cas douteux ou négatifs, alors que tous ceux du 3e degré ont réagi positivement. Quoi qu'il en soit, l'ophtalmo-réaction semble donc d'après ces expériences, bien loin de l'infaillibilité.

MM. Sougues et Cawadias ont recherché chez 15 malades adultes, indemnes de toute lésion tuberculeuse, d'abord la réaction générale fébrile (injection hypodermique de tuberculine) et ensuite l'ophtalmo-réaction. Chez 12 sur 15 il y a eu une réaction nette soit fébrile, soit oculaire. Mais, dans la moitié des cas, ces deux réactions n'ont pas concordé, la fébrile existant alors que l'oculaire manquait ou inversement.

M. de Massary sur une trentiane de cas a obtenu des résultats discordants. Dans un cas, où par trois fois, l'ophtalmo-réaction avait été positive, il trouva seulement une carcinose généralisée.

M. Mery a réuni 210 cas qui ne l'ont pas convaincu de la perfection de la méthode. Il insiste particulièrement sur 16 cas qui répondaient cliniquement à la tuberculose pulmonaire ou ganglionnaire dans lesquels l'ophtalmo-réaction a été négative.

Peut-être pourrait-on expliquer en partie les divergences dans les résultats constatés par les origines et les titres différents des tuberculines employées; tuberculine de Koch, tuberculine Billon, tuberculine Calmette, tuberculine médicale, toutes ont été utilisées.

Ce qui, peut-être, est plus important encore, c'est le titre de la dilution. M. Morel a remarqué que les réactions trop fortes qu'il obtenait au début ont disparu lorsqu'il n'a plus utilisé que la solution médicale de l'Institut Pasteur à $\frac{1}{100}$e.

M. Comby a renoncé à la solution Calmette à $\frac{1}{100}$e qui lui donnait des réactions excessives pour ne plus employer que la solution à $\frac{1}{200}$e. Nous avons vu que, plus prudent encore, M. Lesné s'adresse à une dilution à $\frac{1}{500}$e.

Bien d'autres travaux, bien d'autres communications mériteraient d'être résumés ici; toujours aux éloges que les uns consacrent à la méthode, nous pourrions opposer les reproches que les autres lui adressent. La tribune de l'Académie de Médecine a entendu récemment soutenir les deux thèses adverses, l'une par M. Delorme, l'autre par M. Calmette.

Quoi qu'il en soit, il ne nous paraît pas douteux que les résultats apportés jusqu'ici ne permettent d'affirmer que l'ophtalmo-réaction n'est pas infaillible. D'ailleurs, il est quelquefois difficile de dire où commence et où finit la réaction positive. Entre la réaction franchement négative et la réaction positive s'échelonne toute une gamme de cas que nos collègues ont dû interpréter et sur lesquels M. F. Arloing a particulièrement insisté.

Il semble, qu'après l'instillation oculaire trois sortes de cas peuvent se présenter.

Ou bien la réaction est franchment positive. Elle se caractérise par une rubéfaction intense des conjonctives bulbaire et palpebrale allant quelquefois jusqu'à un léger degré de chémosis. Cet oedème porte surtout sur la caroncule. En même temps, il y a du larmoiement et un peu de sécrétion muco-purulente. Quelques phénomènes subjectifs (photophobie, céphalée) rendent la réaction un peu douloureuse.

Le moment d'apparition de cette réaction est très variable. Elle est quelquefois très précoce, ayant son maximum d'intensité au bout de quelques heures. Plus rarement elle apparaît tardivement, quelquefois seulement au 4 ème jour.

Ou bien la reaction est franchement négative; dans les quelques heures et dans les quelques jours qui suivent l'instillation, aucun phénomène réactionnel n'est visible.

Ou bien enfin la réaction est douteuse.—L'oeil est un peu rouge, la conjonctive palpébrale surtout est légèrement injectée, la caroncule est plus rouge qu'à l'ordinaire. Un peu de muco-pus apparaît au grand angle de l'oeil, mais en si petite quantité que l'on se demande s'il ne s'agit pas d'un état banal. Ces cas douteux sont fréquents: sur 63 observations, M. Jugeat en trouva 14, sur 78, M. Morel en trouve 11. M. Fernand Arloing sur 41 malades tuberculeux trouvait 9 fois la réaction douteuse.

Peut-être, en analysant bien les cas, pourrait-on arriver à réduire le nombre de ces doutes? Pour avoir suivi les expériences de nos collègues sur les Bovidés, j'ai pu me rendre compte combien l'interprétation de pareils cas est difficile; observation dans des étables sombres, avec l'éclairage de fortune qu'on y peut rencontrer, mauvaise volonté de la part des animaux qui ferment les yeux dès l'approche de l'observateur. Il est vraisemblable de dire que beaucoup de conjonctivites légères observées dans de telles conditions sont dues, plus aux efforts de l'expérimentateur pour ouvrir les paupières qu'à l'instillation même de tuberculine. C'est pourquoi, il me paraîtrait absolument imprudent de tenir compte, en médecine vétérinaire, de ces cas douteux; il vaut mieux les considérer comme franchement négatifs.

L'observation chez l'homme et chez l'enfant est autrement simple: facilité de l'examen avant et après l'instillation en pleine lumière, comparaison facile, évidente même entre l'état des deux yeux. Cette comparaison de l'oeil éprouvé avec l'oeil indemne est une condition capitale de l'expérience; mais pour qu'elle soit tout-à-fait complète, il fraudrait prendre soin d'instiller, du côtè opposé, une quantité semblable de la solution même qui a servi à la dissolution de la tuberculine, sérum physiologique le plus souvent. Il est banal, en effet, de voir certaines conjonctives beaucoup plus sensibles que d'autres, réagir violemment quelquefois à l'instillation d'une simple

goutte d'eau distillée. Cette réaction banale est d'ailleurs toujours passagère; elle apparaît immédiatement après l'instillation et quelle que soit sa durée, elle va en diminuant d'heure en heure. La réaction à la tuberculine, au contraire, n'est pas immédiate; si bien que, lorsqu'un oeil ayant été éprouvé au moyen de la tuberculine, n'étant plus rouge à la fin de la première heure, recommence un peu plus tard vers la troisième heure, ou plus loin même de l'expérience, à présenter quelques phénomènes de réaction, on est en droit, même si cette réaction est légère, de lui attribuer une valeur positive.

Quelquefois la réaction ne se produit pas seulement du côté instillé, mais encore, par une irritation reflexe, elle gagne l'oeil opposé.

S'il y a des cas trop légers, on en cite aussi de trop violents. M. Morel nous en signale où la réaction ne fut pas locale seulement, mais générale. MM. Dumarest et F. Arloing citent chez l'homme des cas analogues: lassitude, courbature, malaise générale vague avec céphalée diffuse; dans un cas même, ces observateurs virent apparaître des vomissements et de la fièvre. Mais ce ne sont là, fort heureusement, que des cas exceptionnels. Dans l'immense majorité des cas, l'ophtalmo-réaction ne s'accompagne d'aucun événement fébrile.

Reste un dernier côté de la question à envisager. Quels sont les dangers, pour l'oeil, de l'ophtalmo-réaction? Car il est évident que si l'instillation de quelques gouttes de tuberculine dans l'oeil pouvait déterminer du côté de cet organe des lésions oculaires ou autres, la méthode serait par avance condamnée.

En médecine Vétérinaire on n'a pas noté d'accidents graves: quelques faits analogues à ceux que M. Morel range sous le nom de "ophtalmies tuberculiniques"; gonflement énorme des paupières, sécrétion muco-purulente avec phénomènes douloureux et photophobie qui semblent indiquer une participation de la cornée aux phénomènes inflammatoires; voilà les seuls inconvénients que nos confrères vétérinaires ont pu relever à ce point de vue.

Il est vrai que de pareils faits ont pu leur paraître désagréables, et leur ont quelquefois attiré des reproches de la part du propriétaire, voire même de certains vétérinaires peu favorables à la méthode. Mais en somme, ces accidents ont toujours guéri au bout d'une dizaine de jours de soins légers; peut-être, en cherchant bien, trouverait-on quelque altération persistante et légère du côté de la cornée, telle que de légers leucomes; mais le fait est de bien peu d'importance qu'une vache laitière condamnée à passer à la boucherie en sortant de son étable, ait une vision quelque peu imparfaite. D'autant plus que, comme je l'ai dit, le fait n'est nullement démontré.

Il en serait tout autrement en médecine humaine: si l'ophtalmo-réaction peut amener dans quelques cas, si faible que soit le pourcentage, des altéra-

tions persistantes, mêmes les plus légères, elle est mauvaise et nous devons la rejeter.

On a rapporté pour l'homme, comme M. Morel l'a fait pour la vache, un certain nombre d'ophtalmies persistantes; quelques-unes mêmes ont inquiété les expérimentateurs et nécessité l'intervention de l'oculiste. Ces cas ne sont pas encore très nombreux. M. de Lapersonne vient d'en rapporter quelquesuns. Tous ceux que l'on a signalés d'ailleurs, sont légers: cas de kerato-conjonctivite bénigne disparaissant en quelques jours, un cas de conjonctivite purulente, quelques ulcéres marginaux de la cornée. M. F. Arloing a signalé le premier une certaine mydriase survenant à la suite de l'ophtalmo-réaction; cet auteur la considère, à juste raison, comme un symptôme absolument bénin qu'il met sur le compte de l'action vasodilatatrice de la tuberculine.

Dans sa Séance de Novembre 1907, la Société d'Ophtalmolegie de Paris a cru devoir s'occuper de la question. Dans une séance précédente, M. Kalt, Médecin des Quinze-Vingts, avait présenté un sujet atteint de scléro-kératite ancienne de l'oeil droit, avec synéchies iriennes, et à gauche, un foyer récent de scléro-kératite. Pas de signes généraux de tuberculose. Le traitement syphilitique ne donnant aucun résultat, l'oeil droit, l'oeil anciennement malade, dans lequel les lésions étaient absolument au repos, fut éprouvé au moyen de quelques gouttes de tuberculine à 1°/00. La réaction fut positive, décelant la nature tuberculeuse de l'affection; malheureusement, des phénomènes graves lui succédèrent, scléro-kératite intense, trouble de la cornée. La poussée aiguë dura un mois; après disparition des phénomènes inflammatoires, M. Kalt constata la persistance peut-être définitive du trouble cornéen.

A la même séance, M. Terrien rapportait l'observation d'une jeune fille de 18 ans qui lui fut amenée à la suite d'une ophtalmo-réaction positive (instillation de tuberculine Calmette à 1% faite plus d'un mois auparavant). La réaction persistait encore et de plus, on constatait sur la conjonctive tarsienne des paupières supérieure et inférieure, une petite éruption de tubercules confluents. La nature tuberculeuse de ces produits fut vérifiée par inoculation. Le point faible de cette observation est que le sujet n'avait pas été vu par un oculiste avant la réaction: il n'est donc nullement prouvé que cette tuberculose conjonctivale n'existait pas déjà, à l'état latent, avant l'ophtalmo-réaction.

D'autres faits, beaucoup plus légers, de simple persistance de réaction sous forme de kérátite bénigne, pourraient, je crois, être rapportés. De ce que nous en connaissons déjà, nous pourrions tirer les conclusions suivantes:

L'ophtalmo-réaction sur un oeil qui ne présente pas de lésions tuberculeuses, est toujours sans aucun danger ou ne produit que des lésions bénignes et négligeables.

La même réaction sur un oeil à lésions tuberculeuses, en évolution ou latente, peut exagérer ou réveiller ces lésions.

Mais de telles conclusions ne peuvent être encore définitives; il nous faut d'autres cas, plus nombreux, pour qu'elles puissent le devenir. M. Morax ne peut pas admettre qu'une tuberculine bien préparée, c'est-à-dire privée de bacilles vivants, puisse déterminer l'apparition de symptômes tuberculeux sur une conjonctive jusque là saine. Il ne croit pas que l'on puisse prétendre qu'il y a danger à instiller de la tuberculine dans un oeil déjà tuberculeux.

Il est certain que la tuberculine en injections sous-cutanées a déjà été employée, non comme moyen de diagnostic, mais comme procédé thérapeutique, par quelques oculistes. Je me souviens d'un cas observé chez M. Darier, où les injections sous-cutanées amenèrent une amélioration très notable d'une tuberculose de la choroïde, et ce cas est d'autant plus intéressant qu'aux injections sous-cutanées, M. Darier avait ajouté les injections sous-conjonctivales de tuberculine. L'action du produit, très dilué, il est vrai, était évidemment beaucoup plus directe qu'en simple instillation.

Enfin, dernier cas à rapporter, M. Rochon Duvigneaud ayant traité une irido-cyclite chronique tuberculeuse, rebelle à tout traitement, par les injections sous-cutanées de tuberculine, vit d'abord une aggravation des lésions pendant deux ou trois semaines, qui fut suivie d'une guérison complète de l'affection.

Plus récemment encore, au dernier Congrès de la Société Française d'Ophtalmologie (mai 1908) M. Aubineau de Brest n'a observé qu'une seule complication d'iritis, sur 69 malades qui soumis à l'oculo-réaction n'avaient jamais présenté aucune lésion oculaire.

Au contraire, sur 13 malades présentant ou ayant présenté différents accidents du côté de la vue, il vit survenir sept complications dont trois laissèrent après elles des troubles définitifs de la vue.

Nous avons rapporté ces quelques cas pour établir ce que nous disions tout-à-l'heure: puisque la tuberculine en injections sous-cutanées a pu produire des guérisons de lésions intra-oculaires, on ne peut pas prétendre d'une manière définitive qu'une simple instillation du même produit à la surface du globe oculaire, amène toujours une aggravation des lésions. Mais, cependant, des faits observés par des auteurs aussi compétents que M. Kalt nous obligent, jusqu'à nouvel ordre, à maintenir, comme provisoires, les conclusions que nous donnions tout-à-l'heure.

Nous en arrivons donc à cette conviction que si l'ophthalmo-réaction est souvent infidèle, elle n'est *que rarement* dangereuse lorsque l'oeil instillé est indemne de toute lésion tuberculeuse. Mais, au point de vue pratique, quels services en pouvons-nous attendre?

La question paraît jugée au point de vue Vétérinaire: d'un côté une méthode rarement en défaillance, celle de la sous-tuberculination; de l'autre, l'ophtalmo-réaction avec une proportion de 13 à 15% d'insuccès. Sans doute, des deux méthodes, la dernière est autrement facile; elle simplifie la technique opératoire, en supprimant les prises de température qui, de l'avis de tous les vétérinaires, sont des causes répétées d'ennuis et d'erreurs, elle effraie moins le porpriétaire, qui se prêtera toujours plus volontiers à une expérience aussi simple. Mais quelle confiance avoir en elle, si 15 fois sur 100, les résultats doivent être infidèles.

L'ophtalmo-réaction serait donc à rejeter; nos collègues MM. Jugeat et Morel sont parfaitement d'accord sur ce point et ce que nous avons vu de leurs expériences nous rapprocherait plutôt de cette manière de voir. D'autant plus que dans leurs dernières séries d'expériences, ces deux auteurs arrivent exactement aux mêmes conclusions: leur opinion n'a pas varié sur ce point. L'oculo-réaction, procédé de diagnostic facile et agréable, à coup sûr, n'a pas donné ce qu'on aurait pu espérer; ses résultats ne sont pas toujours concordants. Notre opinion ne saurait être différente de la leur: on ne peut que regretter qu'un moyen aussi simple ne puisse pas être en même temps un moyen sûr de diagnostic et il nous apparaît que la médecine vétérinaire l'abandonnera rapidement.

Les nouvelles expériences de nos collègues ont porté surtout sur un deuxième procédé, qui au mois de Décembre déjà, à la suite des travaux de M. Jugeat, bientôt confirmés par ceux de M. Morel nous semblait plein d'avenir.

Guérin pour les bovidés, Lemaire pour l'homme avaient signalé ce fait qu'une sous cuti-tuberculination réveille ou fait apparaître des réactions oculaires, si elle est faite quelques jours après l'oculo-réaction. A la Société de Biologie (séance du 12 Octobre 1907) Calmette, Breton et Petit avaient signalé le réveil de la réaction conjonctivale chez certains sujets sains ou tuberculeux, sous l'influence d'une injection sous-cutanée de tuberculine.

M. Jugeat reprenant ses expériences et cherchant à en tirer un moyen de diagnostic, dans une première publication au mois de Novembre dernier, donnait à la Société de Pathologie Comparée les résultats vraiment encourageants qu'il en avait obtenu. Depuis, poursuivant ses travaux, il a fait part d'une série d'expériences à la Société Centrale de Médecine Vétérinaire au Mois d'Avril dernier. Il nous a soumis enfin le résultat d'une nouvelle série d'expériences encore complétement inédites.

Son expérimentation a porté jusqu'ici sur 159 animaux. Notons en passant, pour ne plus y revenir, que l'oculo-réaction simple sur ces 159 cas lui donnait 27 discordances, soit 18% avec les résultats fournis par la tuberculination.

Au contraire, l'oculo-réaction seconde, apparaissant après tuberculination ne lui donnait plus que 13 discordances, soit seulement 8%.

Etudions de plus près ces discordances en nous occupant uniquement de la réaction oculaire secondaire. Pour plus de clarté, nous adopterons les formules schématiques de M. Jugeat qui permettent d'un simple coup d'oeil de comprendre le résultat positif ou négatif d'une réaction. Les discordances peuvent se produire suivant deux formules:

Ou bien la réaction oculaire seconde étant nulle, la réaction thermique se produit cependant. Dans ce cas, la formule est la suivante: 0″—th+

Ou bien la réaction oculaire existe sans réaction thermale, la formule devient 0″+th —

13 fois, M. Jugeat trouve 0″ + th —

3 fois, il trouve .....0″ — th +

Les tableaux seront d'ailleurs ultérieurement publiés intégralement dans un prochain Bulletin de la Société de Pathologie Comparée.

M. Jugeat conclut de ces expériences, que, à n'en pas douter, la réaction oculaire seconde est bien supérieure à la réaction oculaire simple, à la véritable ophtalmo-réaction, mais que ce procédé n'est pas infaillible, qu'il se trompe de deux façons: ou bien en laissant passer sans les signaler des animaux tuberculeux, ou bien en indiquant comme tuberculeux des animaux qui ne le seraient pas, le criterium étant dans tous les cas, l'épreuve de la tuberculination supposée infaillible. Ce qu'il en retient avant tout comme avantage pratique, c'est la grande simplification que le Vétérinaire hésitant quelquefois devant les prises de température, pourra en retirer.

Complétant les premières expériences qu'il avait faites après la communication de M. Jugeat, M. Morel apporte aujourd'hui de son côté le résultat d'une longue pratique de l'oculo-réaction seconde. Il reste évident pour lui que l'oculo-réaction simple est souvent infidèle et ne peut être érigée en procédé de diagnostic. Il en est tout autrement, à son avis, de la réaction oculaire qui suit la tuberculination. Dans une série de travaux encore inédits, qui ont fait l'objet de communications encore non publiées à la Société Centrale de Médecine Vétérinaire (décembre 1907 et février 1908), il apporte les résultats de 98 cas où il a pu employer le procédé.

Sur ces 98 animaux, 60 ont été reconnus tuberculeux par les deux procédés, examen de la température et réaction oculaire seconde, l'oeil étant exploré à la tuberculine quelques jours auparavant.

Sur ces 98 cas, il y a eu 7 discordances, à savoir:

2 fois la réaction thermale a eu lieu sans réaction locale,

5 fois la réaction locale s'est produite sans réaction générale.; soit 7, 5% environ de discordance.

Rappelons que les expériences de M. Jugeat donnent le chiffre de 8% et que cette similitude est d'autant plus intéressante à signaler que nous savons de source absolument sûre que tous deux ont toujours procédé dans leurs recherches parallèment sans que l'un pût connaître les résultats de l'autre.

L'un comme l'autre nous signale parmi les discordances, comme plus fréquente, la réaction locale apparaissant sans réaction thermale. Notons ce fait sur lequel nous aurons à revenir tout-à l'heure.

Les expériences de M. Morel l'amenèrent à conclure que l'oculo-réaction combinée est infiniment plus précise que l'oculo-réaction première, qu'elle peut apparaître chez des animaux n'ayant pas réagi à cette oculo-réaction simple, qu'elle est la règle chez les animaux devant réagir à la tuberculination.

Ce sont en somme, à peu de chose près les mêmes conclusions que nous apportent nos deux collègues.

Etudions donc, grâce à leurs intéressants travaux la question dans son ensemble. Certes ils nous apportent des éléments d'appréciation tout-à-fait remarquables, et nous ne saurions trop les en féliciter, tant par le grand nombre de leurs expériences que par l'esprit scientifique dont elles sont empreintes.

Aucun auteur ne peut, à notre avis, prétendre avoir plus qu'eux la pratique du procédé. Nous ne pouvons donc mieux nous en faire une idée qu'en analysant leurs travaux. Nous ne saurions cependant oublier d'autres travaux postérieurs aux leurs, mais intéressants cependant au plus haut point, comme celui de M. Vallée qui a paru dans la Revue de Médecine Vétérinaire du mois de Mars dernier.

Nous nous trouvons donc en face de 257 cas, soigneusement examinés au point de vue de l'oculo-réaction. A quelques divergences près sur des points de détail sur lesquels nous aurons à revenir, tous les animaux ont été traités de la même façon: instillation de tuberculine dans un oeil, l'autre étant pris comme témoin, puis 4 à 5 jours après, injection sous cutanée de tuberculine, et le lendemain examen des yeux. Sont considérés comme positifs tous les cas où la réaction est forte avec muco-pus.

Sur ces 257 cas, nos confrères nous signalent 20 discordances, c'est-à-dire que la méthode comparée à la tuberculination considérée comme pierre de touche a été dans 7, 8% faillible.

Analysons les cas de discordances: le désaccord peut se produire, nous l'avons déjà vu de deux façons: réaction locale positive avec thermo-réaction négative, ou réaction locale négative avec thermo-réaction positive.

Etudions le premier cas 0″ + th —; nous le rencontrons 15 fois, c'est-à-dire que sur 257 cas animaux, la réaction oculaire en indiquait 15 tuberculeux qui en réalité ne l'auraient pas été: nos confrères se seraient donc de ce fait trompés 6 fois sur 100.—Sur 100 vaches, il leur serait arrivé 6 fois d'être trop sévères.

Etudions le 2 ème cas 0″ — th + : nous le rencontrons 5 fois. Le procédé employé seul aurait laissé passer au crible de l'examen 5 vaches sur 257 alors qu'elles étaient tuberculeuses. Sur 100 vaches il y en aurait eu 2 qui, tuberculeuses n'auraient pas été reconnues.

Vraiment, le résultat est encourageant, car il nous importe relativement peu que le procédé soit trop sévère, et il paraît vraiment l'être; il sera toujours temps par une deuxiéme épreuve à la tuberculine de corriger cet excès de sévérité. Ce que nous demandons à ce procédé, c'est de ne pas laisser passer de tuberculoses sans les signaler: or, que voyons-nous? Le fait ne se passe que 2 fois sur 100. Comme nul procédé de diagnostic ne peut passer pour infaillible, nous avons le droit de considérer comme remarquable un tel résultat. D'autant plus qu'en fin de compte, comme nous l'avons déjà signalé dans toutes ces expériences, ce n'est pas l'autopsie qui fut le critérium, mais la réaction thermique: réaction parfaite, il est vrai, mais comme toute autre susceptible d'erreur. Nous en trouvons un cas dans les expériences de nos collègues; il y en aurait eu d'autres, peut-être, si toutes les autopsies avaient pu être pratiquées. On peut se demander, si avec le contrôle de l'autopsie, le chiffre de ces cas où l'oculo-réaction se serait trompée, n'aurait pas été singulièrement diminué.

Quels services la médecine vétérinaire peut-elle espérer retirer de ce procédé? Le premier, très appréciable à coup sûr est de diminuer le nombre des prises de température qui sont pour le vétérinaire une véritable cause d'ennuis et d'erreurs répétés. L'oculo-réaction seconde permet en outre la surveillance par le praticien du personnel qu'il a chargé des constatations thermiques. Pour le vétérinaire sanitaire, cela peut-être un avantage inappréciable. Parmi les animaux qu'on lui signale comme sans réaction thermale en aperçoit-il un dont les yeux sont rouges, injectés, couverts de muco-pus, qu'il fasse reprendre la température devant lui.

Enfin après M. Vallée, nos collègues ne manquent pas de signaler le grand avantage que l'on peut retirer du procédé en police sanitaire pour lutter contre les tentatives frauduleuses des propriétaires, ne craignant pas d'injecter avant la visite à l'abattoir ou à la frontière leurs animaux tuberculeux pour empêcher toute réaction thermale à la suite d'une nouvelle injection; mais en cas de tuberculose, cette précaution malhonnête n'empêchera pas l'apparition de la réaction oculaire.

Pratiquement, il faut donc comprendre le procédé de la façon suivante: il ne supprime pas la sous-cuti tuberculination, puisque cette injection sous-cutanée est nécessaire à la réaction: c'est un moyen de contrôle au cas où la réaction thermale est signalée comme negative; il faut dans ce cas ordonner une nouvelle tuberculination un mois après. De plus le vetérinaire trouve la tuberculination simplifiée puisque le nombre des prises de température est diminué; la première notamment, la plus ennuyeuse peut ainsi être, nous dit M. Morel, supprimée sans inconvénient.

Entrons maintenant plus avant dans la pratique de l'opération. M. Morel donne les conseils suivants qui nous paraissent parfaitement faciles à suivre ''Lors de votre première visite sanitaire, dans une étable contaminée,

après avoir noté l'état des yeux, tout en prenant le signalement des animaux, instillez dans l'oeil, (l'autre reservé comme témoin), à l'aide d'un compte-gouttes et en faisant saillir le corps clignotant, 2 gouttes de tuberculine, soit médicale, soit brute, diluée à $\frac{1}{20}^{e}$ ou $\frac{1}{30}^{e}$; trois, quatre, cinq jours après, revenez faire votre injection sous-cutanée (comme pour une tuberculination ordinaire) et notez l'état des yeux. Le lendemain vers 7 à 8 heures du matin, vous viendrez relever la 1ere température ou la 2eme (la première pouvant dans ce cas être prise sans danger par le nourisseur). Vous observerez déjà que plusieurs animaux ont l'oeil rouge, pleurent ou même ont déjà un petit exsudat muco-purulent, à l'angle interne de l'oeil. A la 13eme heure, le nombre des réactions oculaires pourra être augmenté, s'il y à plusieurs cas de tuberculose et la réaction oculaire sera encore plus apparente chez les vaches ayant déjà réagi. Ce sont les animaux à réaction oculaire seconde qui auront de la température et non les autres. Peut-être vous arrivera-t-il de rencontrer une vache qui aura de l'élévation thermique sans réaction organique, mais en tout cas, je crois qu'il est bien rare qu'une vache à réaction oculaire positive et bien accentuée (à secrétion muco-purulente) soit indemne de tuberculose."

A ces conseils pratiques il n'y a rien à ajouter; on ne saurait trop insister sur la nécessité de ne tenir que des réactions franches. L'oculo-réaction simple a pu déterminer des conjonctivites banales, par irritation mécanique dont je parlais dans la première partie de ce rapport; ce sont des réactions banales disparaissant après quelques jours, que l'on ne voit pas reparaître après la tuberculination. C'est à notre avis tout le secret des "réactions disparition," que signale en passant notre collègue, M. Morel.

Chez l'homme, cette réaction combinée peut-elle avoir le même intérêt? Non certes: d'abord la simple ophtalmo-réaction est plus facile, plus sûre dans ses résultats qu'en médecine vétérinaire. De plus cette réaction combinée n'aurait aucun avantage sur la simple tuberculination que bien des médecins hésitent encore à employer, dans la crainte d'une réaction générale trop violente.

Il est permis cependant de se demander s'il ne serait pas possible en injectant sous la peau de l'homme une quantité de tuberculine infinitésimale, trop faible pour provoquer une réaction même légère, de rendre l'oeil sensible à l'ophtalmo-réaction. Si ce procédé donnait quelques résultats, la méthode de l'oculo-réaction seconde pourrait, en médecine humaine être utilement employée.

Il ne nous appartient pas de fournir une explication de cette réaction seconde, de cette sensibilisation de l'oeil éprouvé, à la suite de la tuberculination. Le phénomène lui-même de l'ophtalmo-réaction est encore mal élucidé dans sa pathogénie: il appartient à d'autres qu'à nous d'aborder le côté théorique de la question.

Conclusions.

L'étude de la question et des travaux que nos collègues nous ont soumis nous amène aux conclusions suivantes:

1°.—L'ophtalmo-réaction est un procédé de diagnostic qui est généralement sans danger, s'il n'est appliqué que sur des yeux indemnes de toute lésion tuberculeuse. Elle est quelquefois suivie d'accidents bénins et passagers;

2°.—La réaction n'est pas toujours proportionnée à la gravité des lésions. Souvent même elle manque dans les dernières périodes de la tuberculose;

3°.—Elle est quelquefois suivie d'une réaction générale, toujours légère et passagère;

4°.—Très souvent la réaction est douteuse. Chez les bovidés, à cause des difficultés d'examen, les cas douteux doivent être considérés comme négatifs. Chez l'homme, le nombre de ces cas douteux peut-être très réduit si l'on prend la précaution de comparer avec l'oeil congénère, éprouvé au moyen d'une solution dénuée de tuberculine et de noter exactement le moment du début de la réaction;

5°.—Chez l'homme, l'ophtalmo-réaction simple, sans être infaillible parait appelée à rendre de réels services, en décelant l'existence de lésions jusque là inaperçues;

6°.—Chez les bovidés, l'ophtalmo-réaction simple, procédé très infidèle, ne peut prétendre remplacer la méthode de tuberculination. L'ophtalmo-réaction seconde donne des résultats bien supérieurs;

7°.—Dans l'immense majorité des cas les deux procédés, sous cuti-tuberculination simple et ophtalmo-réaction combinée donnent les mêmes résultats;

8°.—Il est exceptionnel qu'un animal tuberculeux ne réagisse pas à cette oculo-réaction seconde. Il est plus fréquent de voir une réaction oculaire positive chez un animal non tuberculeux;

9°.—L'ophtalmo-réaction combinée incapable de détrôner comme procédé de diagnostic la sous cuti-tuberculination, reste un moyen commode, infiniment plus simple, capable de rendre dans certains cas de réels services.

Bericht dargeboten im Namen der Société de Pathologie Comparée. (Commission über Ophthalmo-Reaktion.)—(Bailliart.)

Das Studium der Frage und der Untersuchungen, die von unseren Collegen dargeboten werden, bringt uns die folgenden Schlüsse:

1. Die Ophthalmo-Reaktion ist eine diagnostische Methode, die gefahr-

los ist, wenn dieselbe nur an Augen angewandt wird, welche von tuberkulösen Affektionen ganz frei sind. Manchmal folgen ihr milde und vorübergehende Unfälle.

2. Die Reaktion ist nicht immer der Schwere der Affektionen proportioniert. Ganz häufig fehlt sie sogar während der letzten Stadien der Tuberkulose.

3. Gelegentlich folgt ihr eine allgemeine Reaktion, die immer gering und vorübergehend ist.

4. Sehr häufig ist die Reaktion zweifelhaft. Beim Rinde müssen zweifelhafte Fälle wegen der Schwierigkeiten der Prüfung als negativ betrachtet werden. Beim Menschen kann die Zahl dieser zweifelhaften Fälle beträchtlich reduziert werden, wenn man Acht nimmt, das behandelte Auge mit dem anderen Auge, das mit einer Lösung frei von Tuberkulin behandelt worden ist, vergleicht, und genau den Augenblick betrachtet, in welchem die Reaktion eintritt.

5. Bei Menschen scheint eine einfache (primäre) Ophthalmo-Reaktion—obschon nicht unfehlbar—dazu bestimmt zu sein, einen wirklichen Dienst zu erweisen, da sie die Existenz von verborgenen Affektionen enthüllt.

6. Beim Rinde ist eine einfache (primäre) Ophthalmo-Reaktion ein sehr unsicheres Vorgehen und kann nicht die Einimpfung mit Tuberkulin ersetzen. Eine secundäre Ophthalmo-Reaktion giebt viel mehr sichere Resultate.

7. In der grossen Mehrheit der Fälle geben die beiden Methoden, einfache subkutane Einspritzung von Tuberkulin und die kombinierte Ophthalmo-Reaktion, dieselben Resultate.

8. Nur ausnahmsweise vermisst man in einem tuberkulösen Tiere diese zweite Ophthalmo-Reaktion. Häufiger sieht man eine positive Augenreaktion in einem nicht-tuberkulösen Tiere.

9. Obschon kombinierte Ophthalmo-Reaktion die subkutane Tuberkulineinspritzung als diagnostische Methode nicht stürzen kann, ist sie doch ein bequemes und unendlich einfacheres Vorgehen, das in gewissen Fällen thatsächlich gute Dienste erweisen kann.

Report Presented in the Name of the Société de Pathologie Comparée. (Commission on the Ophthalmo-reaction)—(Bailliart.)

A study of the question and of the investigations submitted to us by our colleagues brings us to the following conclusions:

1. The ophthalmo-reaction is a diagnostic procedure which is usually without danger if it is applied only to eyes free from tuberculous lesions of any kind. It is sometimes followed by mild and transitory accidents.

2. The reaction is not always proportionate to the gravity of the lesions. Quite often it is even absent during the last stages of tuberculosis.

3. It is occasionally followed by a general reaction, which is always slight and transitory.

4. Very often the reaction is doubtful. In cattle, owing to the difficulties of examination, doubtful cases must be regarded as negative. In man, the number of these doubtful cases may be very much reduced by taking the precaution to compare the treated eye with its fellow, tested with a solution free from tuberculin, and accurately noting the moment when the reaction begins.

5. In man, a simple (primary) ophthalmo-reaction, although not infallible, appears to be destined to render a real service by revealing the existence of hidden lesions.

6. In cattle, a simple (primary) ophthalmo-reaction is a very unreliable procedure, and cannot take the place of inoculation with tuberculin. A secondary ophthalmo-reaction gives very much more trustworthy results.

7. In the vast majority of cases the two procedures, simple subcutaneous injection of tuberculin and the combined ophthalmo-reaction, give the same results.

8. A tuberculous animal only exceptionally fails to react to this second ophthalmo-reaction. It is more frequent to see a positive ocular reaction in a non-tuberculous animal.

9. Combined ophthalmo-reaction, while incapable of displacing subcutaneous injection of tuberculin as a diagnostic procedure, is nevertheless a convenient and infinitely more simple measure, capable of rendering real services in certain cases.

Comunicación presentada en nombre de la Société de Patologie Comparée. (Comisión Sobre la Reacción Oftálmica.)—(Bailliart.)

Un estudio sobre las investigaciones sometidas á nosotros por nuestros colegas, forman la base de las concluciones siguientes:

1. La reacción oftálmica en el procedimiento del diagnóstico es por lo general sin peligro, cuando ésta se hace en los ojos libres de lesiones tuberculosas. Esta es algunas veces seguida de accidentes ligeros y transitorios.

2. La reacción no está siempre en proporción con la gravedad de las lesiones. A menudo ésta no se manifiesta durante el último período de la tuberculosis.

3. Es algunas veces acompañada de una reacción general la cual es siempre ligera y transitoria.

4. Muchas veces la reacción es dudosa. En el ganado, debido a la dificultad del examen, casos dudosos deberán conciderarse como negativos. En el hombre, el número de estas reacciones dudosas puede disminuirse si se toman las precauciones necesarias, esto es, comparando la reacción con el ojo opuesto en el cual se ha instilado otra solución que la de la tuberculina, y observar cuidadosamente el momento en el cual la reacción empieza.

5. En el hombre, una simple (primaria) reacción oftálmica, aunque no infalible, parece prestar un sevicio real revelando la existencia de lesiones ocultas.

6. En el ganado, una simple (primaria) reacción oftálmica es un procedimiento inseguro y ésta no puede reemplazar la inoculación de la tuberculina. Una segunda reacción oftálmica da un resultado más satisfactorio.

7. En la mayor parte de los casos los dos procedimientos, la simple inyección subcutánea de la tuberculina y la reacción oftálmica combinadas dan los mismos resultados.

8. En casos excepcionales solamente deja de reacciónar un animal tuberculoso a la segunda aplicacion oftálmica. Es mas frecuente la ocurrencia de una reacción ocular positiva en animales no tuberculosos.

9. La reacción oftalmica combinada, aunque incapaz de reemplazas la inyección subcutanea de la tuberculina en el procedimiento del diagnostico, es sinembargo una medida conveniente y mas simple, capaz de prestar un servicio real en ciertos casos.

OPHTHALMO-TUBERCULIN TEST IN CATTLE.

By David S. White and Eugene McCampbell,
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Early in the fall of 1907 an opportunity was offered us to make a number of experiments to determine the efficacy of a new method of administering tuberculin for the diagnosis of tuberculosis recommended in human practice, namely, the instillation of tuberculin into the conjunctival sacs of tuberculous individuals. Our experiments were first suggested by the results obtained by Calmette on the human subject earlier in the year. The principle employed by Calmette was that of v. Pirquet, who observed that a local reaction was often noted at the point of injection in individuals affected with an infectious disease when the toxin from the microörganism inducing the infection is injected into the body. Von Pirquet applied the phenomenon to tuberculous subjects, and found that when tuberculin is introduced into the dermis, a local reaction followed; in non-tuberculous individuals no reaction of moment occurred. Vallée was probably the first to apply the ophthalmo-tuberculin test to domestic animals, and demonstrated that it possessed some value as a diagnostic agent. Later Vallée employed the ophthalmo-tuberculin reaction in cattle. At about the same time Lignieres, in South America, and we in the United States, experimented with this way of applying tuberculin to diagnose tuberculosis in cattle. This paper is to present in as brief a manner as possible our experience with this method.

First Series of Experiments.

For our first experiments we selected ten head of reacting cattle, *i. e.*, cattle which had given typical reactions to the usual subcutaneous tuberculin test. Five of these animals, which were part of a show herd, are known as Class A. Of these, four were in prime beef condition; one, a full-blooded Jersey cow, was thin in flesh, rough-coated, and subject to paroxysms of coughing. The other five, known as Class B, were grade Jersey cows, poor in flesh, rough-coated, one of them affected with a bad diarrhea. In the feces of this animal tubercle bacilli were found. These animals came from a herd of thirty-four, twenty-seven of which had been condemned after reacting to the tuberculin test. As control, twenty head of cattle were used. These are designated as Class C. With the exception of one (2C), all had

been repeatedly tested with tuberculin by the usual method, the last time being six months before our experiments.

Technic.—The method first tried was the administration of tuberculin as prepared by Calmette. A 1 per cent. solution was made by dissolving the precipitate, obtained by treating tuberculin with absolute alcohol, in sterile water. The solution was sterilized by steam at 100° C. One-tenth to one-fifth of a cubic centimeter (0.1 to 0.2) of the above solution was placed in the conjunctival sac of each cow. No results followed the use of this preparation. The tuberculin which gave the best results was procured from the Bureau of Animal Industry, Department of Agriculture. It was used by us as furnished (full strength) in doses of 0.25 c.c., and instilled with a sterile eye-dropper into the conjunctival sac of each animal. The right eye was used, its condition being noted and carefully compared with the left at the time of the injection. The *modus operandi* of instillation consists in having an assistant grasp the muzzle and horn of the animal and so rotate the head that the eye to be instilled is brought into as nearly a horizontal position as possible. The lower lid is then elevated, and the tuberculin allowed to flow over the lower portion of the bulbar conjunctiva. After instillation gentle massaging of the eyeball through the lid promotes absorption. Too much manipulation, however, induces excessive lacrimation and consequent washing out of the reagent. It is also advisable not to feed hay while the reaction is developing, on account of the cattle rubbing off the exudate which may flow.

Reaction.—Our experiments show that the ophthalmo-tuberculin reaction varies greatly in different animals, and also, to a lesser extent, in one and the same animal. In one cow (3A), for instance, a very marked reaction would be preceded or succeeded by a greater or lesser reaction. In other words, the reaction in a given animal is not always uniform. The intensity of the reaction varied from a mere congestion of the conjunctiva, especially marked in the membrana nictitans, to a pronounced fibrinous conjunctivitis with profuse exudation. Such a reaction, taken from our notes, may be considered of typical intensity: "In the right eye, beginning from six to eight hours after instillation of the tuberculin (0.25 c.c.), the lids appear slightly swollen. Photophobia and lacrimosis are present. Within sixteen to eighteen hours there appears upon the conjunctiva a thin layer of whitish-gray membrane. This is particularly marked on the bulbar conjunctiva covering the sclera and on the membrana nictitans, which is highly reddened. Thin films of this membrane are constantly being washed down over the cornea, where they appear as movable opacities, passing downward to the lower lid. The eyelashes are agglutinated with grayish-yellow exudate. The episcleral vessels are dilated. From the inner canthus is a discharge of straw-colored exudate which dries to form crusts. The left eye is normal."

The above-described reaction was much more marked in the cattle of Class A than it is in Class B. This we at first thought to be due to the fact that these cattle (Class B) has been within a month injected with tuberculin subcutaneously. They were, furthermore, much emaciated and were suffering from a more advanced form of tuberculosis. In other words, a certain degree of inhibition was assumed to be due either to the previous tuberculining, or to the more extensive tuberculosis, or to both. Later experience, however, did not confirm this view to the fullest extent. In fact, experiments showed that the more advanced the tubercular process in the body, the more pronounced the ophthalmo-tuberculin reaction; when subcutaneous injections were made concomitant with eye instillations of tuberculin, the ophthalmo-reaction became intensified. Experiments made upon these two classes (A and B) showed, further, that the hypersusceptibility of the conjunctiva could be increased by spaced instillations of tuberculin when the intervals between the instillations of tuberculin were over two weeks. When shorter (one or two days), the reaction was not so pronounced, but became so again as soon as the intervals were lengthened. On necropsy all of the cattle of Class B were found to be tubercular.

Of the control (Class C), none gave any reaction to the ophthalmic test, save one animal, No. 2C. This cow was the only one of the twenty controls which had not been treated by the usual method previous to our experiments. On necropsy she was found tubercular. Two other cattle, however (Nos. 8C and 10C), of this group which did not react to the ophthalmic test, when later tested by the usual method gave typical (thermic) reactions. On necropsy each was found to be tubercular. It is very possible that these two animals did give slight reactions (+), which, occurring during our first experience with this method, may have been overlooked. In our recent experiments we have noted both antianaphylaxis or immunity and very slight reactions (+). The reaction usually entirely disappears in forty-eight hours.

To graphically present the different degrees of reaction depending upon its intensity, we have adopted, with some modification, the scheme suggested by Baldwin and Comby. It is as follows:

(N) Negative. No difference observed in eyes.
(D) Doubtful. Slight redness of conjunctiva.
\+ Slight engorgement of palpebral conjunctiva with exudation.
\+ + Marked engorgement of the whole conjunctiva, photophobia, lacrimation, exudate.
\+ + + Very marked reaction.

Second Series of Experiments.

Besides the cattle of Class A and of Class B, a new group of tubercular animals were used in these experiments. This group is designated Class D.

In addition, another group of twenty-six non-reacting cattle (temperature test) were used as control. These are known as Class E. Classes D and E were last tested with tuberculin by the usual method in January, 1908.

As in the first series, we found the tuberculin of the Bureau of Animal Industry the most stable and reliable for our experiments in this second series. In most cases it was instilled full strength. In a few cases the tuberculin was concentrated to one-tenth volume. The ophthalmic application of this concentrated tuberculin induced a more severe reaction (+ + +) than when tuberculin of the usual strength was employed. In these experiments smaller quantities, 0.1 c.c., were used. This seemed to give better results, as it caused less lacrimation to wash out the tuberculin before absorption has taken place.

Result.—The ophthalmic reaction occurred in varying intensity in all of the cattle in Class D. Although all of these cattle reacted, the reaction varied from a slight engorgement of the palpebral conjunctiva, with some exudation (+), to a very marked reaction (+ + +) in the different animals. It was noted that the reaction increased in intensity with each instillation so long as the periods between them were no shorter than two weeks. This indicates a marked hypersensitiveness of the conjunctival cells to tuberculin (anaphylaxis). In one case (3D) when four successive instillations were made at three-day intervals, the ophthalmic reaction did not occur after the last two instillations. This would indicate a local immunity (antianaphylaxis). This animal showed on necropsy tuberculosis of the lungs and of the bronchial and mediastinal lymph-glands. One case of "allergie"—that is, acquired immunity associated with anaphylaxis—occurred in a non-reacting cow (4E). This animal, which failed to react to the usual tuberculin test eight weeks before, twice showed a typical ophthalmic reaction to tuberculin. When subsequently tested with tuberculin by the usual method, she again failed to react. This cow is in perfect physical condition. This seems to be a case of artificially induced local anaphylaxis. Similar cases are noted in the human subject by Rosenau and Anderson. It is not common in cattle; we were unable to record another case. In a certain percentage of tuberculous animals the subcutaneous administration of 2 c.c. of tuberculin, occurring at the same time tuberculin was instilled into the eyes, seemed to intensify the ophthalmic reaction. Our experiments further elicited the fact that in most instances the intensity of the ophthalmic reaction was in direct proportion to the extent of the tubercular lesion. This was very marked in some cases. No. 3A, for instance, always gave a marked reaction to the eye test. On necropsy advanced tuberculosis was present. This, of course, differs from the usual tuberculin test, which commonly gives the most pronounced thermic reaction in those cattle which show on necropsy the least tuberculosis. No exceptions to this rule were noted in our experiments.

Ophthalmo-tuberculin Test on Calves.

The dams (2A, 4A, 5A) of these calves had repeatedly reacted to the usual tuberculin test, and several times to the ophthalmo-tuberculin test. Necropsy showed the dams to be extensively tubercular. The ophthalmic test was tried on these calves to determine if any conjunctival hypersensitiveness has been acquired in utero. The instillation of tuberculin into the eye failed to elicit any reaction whatever. Two subsequent instillations likewise produced no effect. The calves were evidently not in a state of anaphylaxis to tuberculin. It has been noted in guinea-pigs that the sensitizing substance can be transmitted to the fetus in utero, and after the birth the offspring give a reaction. It is possible that the calves were antianaphylactic or immune to tuberculin and tuberculosis. Subsequent experiments will be made with these animals.

Ophthalmo-Tuberculin Test on Vaccinated Cattle.

Seven cattle were used in these experiments—six heifers and a young bull. These cattle had received intravenous injections of 1 c.c., 1.5 c.c., and 2 c.c., respectively, of an emulsion of human tubercle bacilli in physiological sodium chlorid solution. Guinea-pigs inoculated with the emulsion intraperitoneally died in four weeks of tuberculosis. A second series, from the first, died in five weeks. The cattle received three injections, six weeks apart. The method is that used by von Behring and modified by Pearson of this country. When the ophthalmic test was applied to these vaccinated cattle, it was noted that three gave on the first test a conclusive reaction which was not very pronounced (+), and four failed to react. On the second test, after an interval of six weeks, three reacting cattle showed an ophthalmic reaction of mild intensity. One heifer showed slightly more conjunctivitis than the others. Four animals failed to react. On the third test, six weeks later than the second, no reactions were observed on any of the cattle. When again tested in eight weeks, two of the three reacting cattle responded to the ophthalmic test. It would seem that at the time of the first test, as a result of vaccination, the three animals were in a state of anaphylaxis, and as a result of the instillation into the eye there was developed a state of antianaphylaxis or immunity. We are inclined to believe that this condition of partially acquired immunity as a result of the ophthalmic test is entirely local, for when these three cattle were subsequently tested with tuberculin by the usual subcutaneous method, they gave temperature reactions. When tested again in six weeks, two showed an atypical reaction and one failed to react. Four animals failed to react to the usual tuberculin test. Pearson explains this fact by stating that the animals subsequent to vaccination are in a condition of hypersus-

ceptibility to tuberculin (anaphylactic). This hypersusceptibility is present for varying lengths of time. It requires, therefore, several injections of tuberculin in these cases which are still hypersensitive to use up or combine with, so to speak, this hypersensitive substance (anaphylactin).

We are not prepared at this time to state whether all these vaccinated animals are tubercular or entirely immune to tuberculosis. Only a necropsy will reveal the truth.

Conclusions and Summary.

We are able to sum up our observations in this series of experiments as follows:

1. The ophthalmo-tuberculin test is of limited value in the diagnosis of tuberculosis in cattle. In some cases the reaction is very slight (hyperemia). In others pronounced congestion with profuse exudates are noted. Accuracy of observation is important. *We are inclined to rely primarily on the result of the first instillation of tuberculin.* Second instillations rarely elicit reactions in non-tubercular animals.

2. In the majority of animals tested the reaction increased in its intensity with each subsequent instillation of tuberculin. This fact indicates the development of a local hypersusceptibility of anaphylaxis associated with a partial immunity. Von Pirquet calls this condition "allergie."

3. It is possible in some cases to create a condition of "allergie" in healthy cattle, when spaced instillations of tuberculin are made. It is evident, therefore, that the result of the first instillation of tuberculin should be made the only basis of diagnosis. Rosenau and Anderson have called attention to this point in regard to the human subject.

4. When repeated instillations of tuberculin are made on the conjunctiva at short intervals (twenty-four hours, etc.), a local immunity (antianaphylaxis) results (3D, *et al.*). If the instillations are separated two weeks or more, anaphylaxis results.

5. We hold, therefore, that if tuberculin (0.1 c.c.) is carefully instilled into the conjunctival sac and the condition of the instilled eye carefully compared with the opposite eye, and a reaction of varying intensity results in from ten to twelve hours after the first instillation, a tubercular lesion is present.

6. While in our first experiments we were inclined to believe that a subcutaneous tuberculin injection given previous to the ophthalmic test would slightly inhibit it, we have since become convinced that this is true only to a limited extent. In some cases the ophthalmic reaction is exaggerated by a subcutaneous injection of tuberculin.

7. The primary ophthalmo-tuberculin reaction is in direct proportion to the extent of the tubercular process in the body. The more extensive

the tubercular lesion, the more anaphylactic the animal is. This is in direct variance with the condition in the usual subcutaneous tuberculin test.

8. We are inclined to believe that the ophthalmo-tuberculin test will reveal tuberculosis at as early a stage as the usual subcutaneous tuberculin test.

9. The ophthalmic reaction is of no value in determining whether vaccinated cattle are actively tubercular or not, or in demonstrating any hypersusceptibility in the offspring of tubercular cattle.*

Prueba de la Oftalmo-tuberculina en el ganado.—(White y McCampbell.)

Durante el otoño de 1907, hicimos un número de experimentos sobre tuberculosis en el ganado de prueba, instilando tuberculina en los sacos conjunctivos. La tuberculina que diá los más felices resultados fué obtenida del "Bureau of Animal Industry," Departamento de Agricultura de los Estados Unidos. Se usó en toda su fuerza tal cual se prepara en el "Bureau" para la aplicación subcutánea usual. Se usaron en el experimento setenta y un animales, incluyendo siete vacunados contra tuberculosis.

Como resultado de estos experimentos los investigadores llegaron á la siguiente conclusión:

1. La prueba de la oftalmo-tuberculina es de valor limitado para el diagnostico de la tuberculosis en el ganado. En algunos casos la reacción es muy débil (Hiperemia). En otros se nota congestión más pronunciada con abundante sudor. Es importante el esmero en la observación. Nos inclinamos á confiar en el resultado de la primera instilación de tuberculina. Las segundas instilaciones raramente traen reacción en animales no tuberculosos.

2. En la mayoría de los animales probados la reacción aumentó en intensidad con cada subsecuente instilación de tuberculina. Este hecho indica el desarrollo de una supersusceptibilidad local ó anafilaxia, asociada con uninmunidad parcia. Von Pirquet llama este estado "alergia."

3. En algunas casos es posible crear un estado de "alergia" en el ganado sano, cuando se hacen instilaciones de tuberculina á intérvalos. Es evidente, por tanto, que el resultado de la primera instilación de tuberculina debe ser la sola base para el diagnóstico. Rosenau y Anderson han llamado recientemente la atención sobre este punto con respecto al hombre.

4. Cuando se hacen repetidas instilaciones de tuberculina en la conjuntiva, á cortos intérvalos (veinte y cuatro horas, etc.) resulta una inmunidad local. Si las instilaciones se espacian dos semanas ó màs, resulta anafilaxia.

* For complete report see Journal of Experimental Medicine, March, 1908; Sept., 1908.

5. Por tanto nosotros creemos que si la tuberculina (1 c.c.) es cuidadosamente instilada en el saco conjuntivo, y el estado del ojo instilado se compara cuidadosamente con el ojo opuesto y si una reacción de intensidad variable resulta de diez á doce horas después de la primera instilación, existe una lesión tuberculosa.

6. En nuestros primeros experimentos estábamos inclinados á creer que las inyecciones subcutáneos, hechas antes de la prueba ocular, afectarían lijeramente; pero nos hemos convencido que esto es verdad sólo hasta cierto punto, y que en algunos casos la reacción oftálmica es exagerada por una inyección subcutánea de tuberculina.

7. La primitiva reacción oftálmico-tuberculina está en proporción directa con la extensión del proceso tuberculoso en el cuerpo. Mientras más extenso es el proceso, más anafilático es el animal. Esto está en directo desacuerdo con la condición en la prueba usual subcutánea.

8. Nos inclinamos á creer que la prueba de la oftalmo-tuberculina revelará la tuberculosis en estado prematuro como la prueba usual subcutánea.

9. La reacción oftálmica no tiene valor alguno para determinar si el ganado vacunado está tuberculoso ó no, ni para demostrar ninguna supersusceptibilidad en la prole del ganado tuberculoso.

L'Ophtalmo-Réaction chez le Bétail.—(WHITE ET MCCAMPBELL.)

Pendant l'automne de 1907, nous fîmes un certain nombre d'expériences sur le bétail avec des instillations de tuberculine dans les sacs conjonctivaux. La tuberculine qui produit les meilleurs résultats avait été fournie par le Bureau de l'Industrie Animale, du Département de l'Agriculture des Etats-Unis. On s'est servi pour les expériences de soixante-et-onze animaux.

Les investigations ont fourni les conclusions suivantes.

1. La réaction-ophtalmo-tuberculine est de valeur limitée dans le diagnostic de la tuberculose chez le bétail. Dans quelques cas la réaction est trés-légère (hypérémie). Dans d'autres on a noté une congestion plus prononcée avec des exsudats profus. Une observation trés-précise est importante. Nous sommes enclins à compter sur les résultats obtenus par une première instillation de tuberculine. Les deuxièmes instillations occasionnent rarement de réaction chez les animaux non tuberculeux.

2. Chez la plupart des animaux traités, la réaction s'est accrue dans son intensité avec chaque instillation de tuberculine. Ce fait indique le développement d'une hypersensibilité locale ou anaphylaxie associée à une immunité partielle. Von Pirquet donna à cette condition le nom "d'allergie."

3. Dans certains cas, il est possible de créer une condition "d'allergie" chez un animal sain, quand des instillations espacées de tuberculine sont pratiquées. Il est donc évident que les résultats de la première instillation devraient constituer la seule base du diagnostic. Rosenau and Anderson ont récemment appelé l'attention sur ce point à propos du sujet humain.

4. Quand des instillations répeteés sont faites sur la conjonctive à de courts intervalles (vingt-quatre heures, etc.) une immunité locale en résulte. Si les instillations sont espacées de deux semaines ou plus, l'anaphylaxie en résulte.

5. Nous constatons donc que, si la tuberculine (1 c.c.) est instillée avec soin, dans le sac conjonctival, et si la condition de l'œil instillé est soigneusement comparée à celle de l'œil opposé, une réaction d'une intensité variante, se manifestant dans l'espace de dix à douze heures après la première instillation, est preuve qu' une lésion tuberculeuse est présente.

6. Dans nos premières expériences nous étions enclins à croire que l'injection tuberculeuse sous-cutanée, donnée avant le traitement oculaire, l'arréterait un peu. Depuis nous avons été convaincus que cela est vrai seulement jusqu'à une certaine limite et que dans quelques cas l'ophtalmo-réaction est exagérée par une injection sous-cutanée de tuberculine.

7. Que la réaction primaire ophtalmo-tuberculine est en rapport direct avec l'étendue du processus tuberculeux dans le corps; plus ce dernier est étendu, et plus l'animal est anaphylactique. Ceci est en désacord avec les conditions dans la réaction sous-cutanée ordinaire.

8. Nous sommes enclins à croire que la réaction ophtalmo-tuberculine révélera la tuberculose dans un étage tout aussi précoce que le fait la réaction sous-cutanée ordinaire.

9. Que l'ophtalmo-réaction n'a aucune valeur pour déterminer si le bétail vacciné est atteint de tuberculose active ou non, ni pour démontrer s'il existe quelque hypersensibilité dans les petits de bétail tuberculeux.

Die Ophthalmo-Tuberkulin-Probe beim Rindvieh.—(White und McCampbell.)

Im Herbst 1907 wurde an Rindern eine Reihe von Versuchen angestellt, indem den Tieren Tuberkulin in den Conjunctivalsack eingetropft wurde. Das Tuberkulin, welches zu den besten Resultaten führte, kam aus dem Bureau of Animal Industry, U. S. Department of Agriculture.

Die Versuche lassen nachstehende Schlussfolgerungen zu:

1. Die Ophthalmo-Tuberkulin-Probe ist von begrenztem Werte in der Diagnose von Tuberkulose der Rinder. In manchen Fällen ist die Reaction eine sehr schwache (Hyperämie). In anderen zeigt sich ausgesprochenere

Congestion, die von profuser Exsudation begleitet ist. Genaue Beobachtung ist unerlässlich. Wir stützen uns stets auf die Ergebnisse der ersten Tuberkulin-Instillation. Weitere Applicationen erzeugen selten Reaction in nicht-tuberkulösen Tieren.

2. In der Mehrzahl der Versuchstiere nahm die Reaction mit jeder nachfolgenden Tuberkulin-Instillation an Intensität zu. Dies weist auf die Entwicklung einer localen Ueberempfindlichkeit oder Anaphylaxis hin, verbunden mit teilweiser Immunität. Von Pirquet nennt diesen Zustand "Allergie."

3. Es gelingt manchmal, in gesunden Rindern einen Zustand von "Allergie" zu erzeugen, wenn abgeteilte Instillationen vorgenommen werden. Hieraus ergibt sich die Notwendigkeit dessen, blos die erste Tuberkulin-Instillation für Diagnose zu benützen. Rosenau und Anderson haben dies vor kurzem auch mit Bezug auf Tuberkulose im Menschen hervorgehoben.

4. Werden Ophthalmo-Tuberkulin-Proben in kurzen Abständen (24 Stunden, u. s. w.) applicirt, so entsteht lokale Immunität. Werden die Instillationen in zweiwöchentlichen oder längeren Abständen ausgeführt, ergibt sich Anaphylaxis.

5. Wir folgern hieraus, dass wenn Tuberkulin (1 ccm.) sorgfältig in den Conjunctivalsack geträufelt wird, der Zustand des instillirten Auges genau mit dem anderen verglichen wird, und in 10–12 Stunden nach der ersten Application eine mehr oder minder starke Reaction auftritt, ein tuberkulöses Leiden vorhanden sei.

6. Gelegentlich unserer ersten Versuche lehnten wir der Ansicht zu, dass subkutane Tuberkulin-Injectionen, vor der Ophthalmo-Tuberkulin-Probe angewandt, diese etwas verwischen. In der Folge kamen wir jedoch zur Ueberzeugung, dass dies nur bis zu einem gewissen Grade zutreffe, und dass in manchen Fällen die Ophthalmo-Reaction durch subkutane Tuberkulin-Injectionen accentuirt werde.

7. Die primäre Ophthalmo-Tuberkulin Reaction steht in directem Verhältnisse zur Ausdehnung des tuberkulösen Prozesses im Körper. Je ausgebreiteter der tuberkulöse Vorgang, um so anaphylaktischer zeigt sich das Tier. Dies steht in directem Gegensatze zu den Verhältnissen bei subkutanen Injections-Proben.

8. Wir neigen der Ansicht zu, dass die Ophthalmo-Tuberkulin-Probe die Tuberkulose in ebenso frühzeitigem Stadium ausweist, wie die übliche subkutane Injections-Methode.

9. Die Ophthalmo-Reaction hat keinen Wert, wo die Frage zu entscheiden ist, ob ein geimpftes Tier an activer Tuberkulose leide oder nicht; oder wo in Sprösslingen tuberkulöser Rinder eine Ueberempfindlichkeit zu eruiren wäre.

SUR UN NOUVEAU MODE DE PRODUIRE CHEZ L'HOMME TUBERCULEUX LA RÉACTION DE LA PEAU A L'AIDE DE LA TUBERCULINE.

Par M. le Professeur T. Lignieres,
Directeur de l'Institut de Bacteriologie du Ministère de l'agriculture, Buenos Aires.

Grâce á la très importante découverte de von Pirquet nous savons que, en mettant un peu de tuberculine sur des scarifications récentes et superficielles de la peau, on produit, chez les tuberculeux, une réaction plus ou moins intense au niveau de ces scarifications, tandis que la cicatrisation se fait d'une manière absolument normale quand il s'agit d'organismes libres de bacilles de Koch; c'est la cuti-réaction de von Pirquet ou cuti-tuberculinisation.

Peu après, Wolff-Eisner et Calmette démontrèrent qu'il existe aussi une réaction locale spécifique quand on fait agir la tuberculine sur la conjonctive.

C'est *l'ophtalmo-réaction* de Wolff-Eisner, Calmette, ou oculo-tuberculinisation.

Dans une note du 18 Septembre 1907, j'ai fait connaitre que la peau des tuberculeux récemment rasée, sans aucune scarification, et simplement frottée avec quelques gouttes de tuberculine brute, donne une réaction spécifique des plus caractéristiques.

J'ai proposé de réserver la dénomination de dermo-réaction à l'opération de von Pirquet parcequ'elle interesse directement le derme, et de donner celle de cuti-reaction ou cuti-tuberculinisation à celle que j'ai indiquée.*

La dermo et la cuti-reaction ne provoquent aucune perturbation thermique ou générale chez les malades; elles peuvent se répéter avec succès presque sans limites, à de très courts intervalles.

Rien n'est plus facile que d'amalgamer la dermo et la cuti-réaction; il suffit de frotter la peau avec la tuberculine sur toute la superficie au lieu de deposer simplement un peu de tuberculine sur les incisions superficielles; c'est là un excellent procède.

Chez les bovins tuberculeux, les frictions de tuberculine sur la peau bien rasée déterminent après 24 ou 48 heures, une réaction inflammatoire

* Depuis, j'ai reconnu que ce changement pouvait produire une confusion, de sorte que je conserve la dénomination de cuti-réaction pour l'opération de von Pirquet et de dermo-réaction pour celle que j'ai indiquée.

spécifique d'une intensité variable: depuis la simple rougeur jusqu'à la tuméfaction œdémateuse avec ou sans eruption vésiculeuse qui se termine par la formation de croûtes.

Sur le lapin, et surtout le cobaye tuberculeuse, la réaction de la peau se produit facilement dans les mêmes conditions, mais surtout sous la forme œdémateuse; on peut ainsi-faire parfois le diagnostic précoce sans nécessité de scarifier les animaux d'expériences.

Chez l'homme, ma dermo-réaction peut rendre aussi d'excellents services; je me propose de m'y arrêter quelque peu dans la présente note.

Technique de la dermo-réaction.—A la face interne du bras, au niveau des biceps, on applique le savon avec un blaireau ordinaire sur une superficée de vingt centimètres carrés environ; ensuite, avec un safety rasoir mécanique, on rase la peau délicatement et en tous sens.

Après avoir enlevé avec de l'eau propre l'exces du savon, puis sèché la surface rasée à l'aide dune serviette ou mieux d'un tampon de coton, il ne reste plus qu'à y déposer 5 à 6 grosses gouttes de tuberculine brute, c'est à dire non diluée, avec lesquelles on frictionne la région (l'emploi de préférence une *tuberculine brute* plus concentrée que celle qu'on trouve d'ordinaire dans le commerce).

Pour faciliter l'absorption, on doit tendre la peau avec la main gauche, tandis que la droite pratique le friction à l'aide *d'un doigt de caoutchouc ou d'un petit tampon de coton* maintenu à *l'extrémité d'une pince.*

Il suffit de frictionner une *ou deux minutes*; on laisse ensuite sécher, l'opération est terminée sans que le patient ait souffert la moindre douleur.

On peut aussi faciliter l'absorption de la tuberculine en frictionnant préalablement la surface rasée avec l'alcool ou le Xylol. La peau rougit et lorsqu'elle est bien sèche, on applique la tuberculine pour faire la friction.

Résultats de l'opération.—Chez les individus tuberculeux, il y a une réaction spécifique que se manifeste à des degrés et sous des formes variables.

Elle est essentiellement éruptive et apparaît, en général, dès la vingt-quatrième heure. Quelquefois elle ne se présente qu'après 48 heurs, et dans des cas exceptionnels plus tard encore.

A la superficée de la peau rasée et frictionnée apparaissent des papules plus ou moins nombreuses, d'une teinte qui varie du rose trés pâle mêlé de jaune ou de gris, jusqu'à rouge foncé et même jusqu'à violacé. A la base de ces papules, on peut noter une auréole de la même teinte.

Les papules sont dans quelques cas si nombreuses qu'elles arrivent à se confondre pour former des ilots confluents plus ou moins étendus, ou même une véritable plaque œdémateuse et rouge d'aspect eczémateux. L'éruption peut s'arrêter au stade de simple papule qui disparait après 4 ou 5 jours sans presque laisser de trace sinon au toucher.

Si la réaction est plus intense, l'éruption arrive jusqu'au stade de vesicule et parfois de vesico-pustule avec formation de vraies croûtes.

Les petites vesicules à centre blanc jaunâtre, s'observent durant plusieurs jours, puis, se fanent peu a peu pour disparaître en un temps variable, jamais moindre d'une semaine.

Après leur disparition, elles laissent une pigmentation rouge ou brunâtre de la peau qui persiste des semaines.

Cette pigmentation est en rapport avec l'intensité de l'éruption.

En même temps que cette pigmentation, on voit souvent se former des pellicules épidermiques blanches à la surface et autour des papules; ces pellicules qui parfois prennent l'aspect de croûtes squameuses peuvent affecter la forme de petites couronnes épidermiques. Durant l'évolution de l'éruption, le sujet présente comme pour la vaccination jennérienne, une sensation de démangeaison en général peu intense. Jamais, ainsi que je l'ai dit au début, on n'observe ni fièvre ni phénomènes généraux.

Differents degrés de réaction.—Pour la facilité des descriptions, je reconnais trois degrés a la dermo-réaction.

1. Dans le premier, les papules isolées ne dépassent pas le nombre de dix.

2. Dans le second degré, il y a plus de dix papules et quelques unes peuvent être confluentes.

3. Enfin le troisième degré est caractérisé par la confluence des papules confluentes formant une plaque surtout au partie de la superficie frotteé avec la tuberculine.

En dehors de ces trois degrés il faut tenir en compte l'intensité de l'éruption. En effet, on observe que dans chacun de ces trois degrés la réaction inflammatoire de la peau peut être faible, moyenne ou violente.

Il sera intéressant d'étudier si ces differentes modalités de l'éruption ont une signification surtout au point de vue du pronostic.

En général, et notamment chez les adultes, la cuti-réaction a, dès les premières vingt-quatre heures, le degré et l'intensité que vont la caractériser. Il y a cependant beaucoup d'exceptions a cette règle. On observe, en effet particulièrement chez les jeunes enfants, des dermo-réactions qui, au début, sont du premier degré et qui passent après plusieurs jours au second degré et même jusqu'au troisième. Chez les jeunes sujets, on constate quelquefois aussi deux ou plusieurs poussées éruptives successives de manière qu'on peut rencontrer à la fois sur la même dermo-réaction, une pigmentation de la peau laissée par d'anciennes papules plus au moins disparues, couvertes ou non de pellicules epidermiques, avec des papules et des vésico-pustules récentes.

Ces dermo-réactions par poussées durent plus longtemps que celles dont l'éruption se fait en un seul temps.

Grace á l'obligeance de M. le docteur José Perma, directeur de l'assistance Publique de Buenos Airês, et de M. le Docteur Maximo Castro, médecin de l'hôpital des Enfants, j'ai pu, avec la collaboration de mes amis les docteurs

Leopoldo Uriarte et Mariano R. Castex, appliquer la dermo-réaction à un nombre assez élévé de sujets des deux sexes et de tous âges atteints de formes varieés de tuberculose ou indemnes de bacilles de Koch. Les résultats seront consignés dans des publications ultérieures.

Sensibilité comparée de l'ophtalmo, de la dermo et cuti-réaction chez l'homme.—Si on répète l'opération plusieurs fois chez les cachectiques, on peut parfois provoquer une réaction positive alors que la première n'avait pas donné de resultat.

En résumé, l'ophtalmo-réaction reste le procedé de diagnostic le plus sensible. La dermo et la cuti-réaction peuvent être tenues comme également constantes sauf dans les cas de cachexie tuberculeuse où le diagnostic clinique est heureusement assez facile à faire.

J'attache plus d'importance à la réaction positive de la dermo-réaction plutot qu'à celle de la réaction oculaire. Pour moi, il ne peut y avoir aucun doute dans le diagnostic tuberculeux si la dermo-réaction est positive, tandis qu'il y a des cas assez fréquents de réactions oculaires douteuses dans lesquelles il est difficile de se prononcer catégoriquement.

Dans la pratique courante et comme je vais l'expliquer un peu plus loin, la dermo-réaction me parait être le mode de diagnostic qui doit être tout d'abord employé.

Si le cas est négatif on compléte le diagnostic par l'ophtalmo-réaction.

Quelques avantages de la dermo-réaction.—La dermo-réaction est non seulement d'une application extremement facile, mais encore nullement douloureuse, de sorte que tous les malades l'acceptent facilement quels que soient leur catégorie sociale, leur sexe, leur âge. Il n'y a pas le plus petit danger d'infection spontanée puisque la peau n'est pas ouverte. Quand la réaction est positive, même si les papules sont rares, elle est tellement caractéristique qu'il ne peut y avoir aucun doute pour les débutants.

La réaction positive cutanée a une valeur absolue. Dans la pratique de la clientèle, il me parait y avoir quelques avantages a faire le diagnostic précoce de la tuberculose en employant tout d'abord la dermo-réaction.

Si celle est positive, le diagnostic est certain. Si elle est négatif, il y a présomption que le sujet n'est pas tuberculeux; on doit alors et comme contrôle pratiquer l'ophtalmo.

En agissant ainsi, on erite aux malades des réactions oculaires parfois un peu trop fortes et inutiles.

La dermo-réaction est particulièrement exact et notable chez les enfants. Je n'ai jamais rencontré le plus léger inconvenient a l'employer, tandis qu'ils acceptent plus difficilement la cuti-réaction de lecture parfois douteuse. Quant à l'ophtalmo-réaction chez les jeunes sujets, elle peut produire ou reveiller dans quelques cas, rares il est vrai, des lésions oculaires durables et désagréables.

A New Method of Producing in a Tuberculous Human Being the Cutaneous Tuberculin Reaction.—(LIGNIERES.)

I. The cuti-reaction of von Pirquet, and the ophthalmo-reaction of Wolff-Eisner and Calmette. The technic and significance of the two reactions.

II. The author's method: If a few drops of crude tuberculin are rubbed into the skin of a tuberculous patient, freshly shaved, without any scarification, a most characteristic reaction is produced. The author proposes to call von Pirquet's test, cuti-reaction, and his own modification dermo-reaction. Neither of these reactions produce the slightest thermic or general disturbance; they may be repeated successfully to an almost unlimited extent, at very short intervals. The two reactions may be combined by rubbing the tuberculin on the entire surface, instead of merely placing a small quantity on the superficial incisions. In cattle, tuberculin rubbed into the skin after shaving, produces in twenty-four hours to forty-eight hours a specific inflammatory reaction of variable intensity, from simple redness to edematous tumefaction, with or without vesicular eruption, terminating in the formation of crusts. The reaction is easily produced under the same conditions in the tuberculous rabbit and guinea-pig, but it usually takes the edematous form.

The possibility of early diagnosis without scarifying the experimental animals: In man the author's dermo-reaction is also capable of doing excellent service.

Technic of the Dermo-reaction.—The skin on the inner surface of the arm at the level of the biceps is lathered with an ordinary shaving brush, over a surface of about 20 square cm., and then shaved with a safety razor in every direction.

Advantages of the safety razor:

After removing the excess of soap with clean water, and drying the shaved surface with a cotton pledget, from five to six large drops of crude tuberculin (not diluted) are rubbed on the prepared surface. To hasten absorption, the skin is put on the stretch with the left hand, and rubbed with a finger on the right hand protected with a rubber finger-cot, or a small cotton tampon held in a pair of forceps. Absorption of the tuberculin may be hastened by previously rubbing the surface with alcohol and xylol. This causes redness of the skin, and as soon as this dries, the tuberculin is applied with friction.

Results of the Procedure.—In normal individuals the skin remains entirely normal. In tuberculous individuals there is a specific reaction manifesting itself chiefly in an eruption, and apparent, as a rule, in twenty-four hours, sometimes delayed for forty-eight hours, and in exceptional

cases still longer. The treated surface is covered with papules ranging in color from a very pale pink mixed with yellow or gray to dark red or even purple. The base of each papule is surrounded by an areola of the same color. Sometimes the papules are very numerous and coalesce to form confluent little islands, or even a large red patch of an edematous appearance. The eruption may stop at the stage of a simple papule, which disappears in four or five days practically without leaving a trace, except to the sense of touch. When the reaction is more intense, the eruption goes on to the vesicular and occasionally to the vesicopustular stage, with the formation of true crusts. The latter is rare in man. The small vesicles with yellowish-white centers persist for several days, then gradually fade, and by the end of a week disappear entirely, in almost every instance. Their disappearance leaves a small red or brownish spot which persists for weeks. This pigmentation is proportionate to the intensity of the eruption. The pigmentation is often accompanied by the formation of white epidermic pellicles or scales on the surface and around the papules; these scales sometimes assume the form of small epidermal crowns. Some itching attends the development of the eruption, as in the case of a vaccination; but fever and constitutional symptoms never develop.

Different Degrees of the Reaction.—(1) Isolated papules not exceeding ten in number. (2) More than two papules, some of them confluent. (3) Confluent papules forming a patch on all or part of the treated surface. The intensity of the eruption must also be taken into account, the inflammatory action of the skin being variable in each of the three degrees of the reaction.

Significance.—In general, and especially in adults, the cuti-reaction develops its characteristic degree of intensity during the first twenty-four hours. There are many exceptions to this rule. In young children especially the dermo-reaction may in the beginning be of the first degree, and in the course of several days go on to the second or even the third degree. Successive crops are sometimes observed in young subjects, so that various stages of the reaction may be present at the same time. When the eruption appears in crops, the duration is longer than when the papules all come out at once. Observations on a number of patients, both normal and tuberculous, form the subject of a later paper.

Comparative Sensitiveness of the Ophthalmo-, Dermo-, and Cuti-reaction in Man.—The ophthalmo-reaction is the most sensitive of all the diagnostic procedures. The dermo-reaction and cuti-reaction are equally constant, except in cachectic cases, in which the clinical diagnosis is fortunately quite easy. (In the latter class the cuti-reaction sometimes proves positive after several attempts, giving it a slight advantage over

the dermo-reaction in this class of cases.) A positive dermo-reaction is more significant than a positive oculo-reaction. It always indicates the presence of tuberculosis. In ordinary practice the dermo-reaction should be employed first, and if it proves negative, the diagnosis may be completed by means of the ophthalmo-reaction.

Advantages of the Dermo-reaction.—Ease of application; painlessness; absence of danger of spontaneous infection, since the skin is not broken. The reaction when positive is absolutely characteristic, and therefore easily interpreted by beginners. A positive cutaneous reaction is of absolute value. In private practice the dermo-reaction should be employed first. If it is positive, the diagnosis is asserted; if it is negative, it is presumptive evidence against tuberculosis, and the diagnosis should be controlled by means of the ophthalmo-reaction. The dermo-reaction is particularly accurate in children. I have never seen the slightest ill effect from its use; while the cuti-reaction is occasionally not well tolerated, and is besides difficult to interpret. As for the ophthalmo-reaction in young subjects, it may produce or revive, in a few rare cases, it is true, permanent and very unpleasant ocular lesions.

SUR L'INTRA-DERMO-RÉACTION A LA TUBERCULINE CHEZ LES ANIMAUX.

PAR LE PROF. G. MOUSSU,
de l'école vétérinaire d'Alfort,

ET LE DR. CH. MANTOUX,
Ancien interne des hôpitaux de Paris, Médecin consultant à Cannes (Le Cannet).

Sous le nom *d'intra-dermo-réaction à* la tuberculine, l'un de nous* a désigné ainsi l'épreuve résultant de l'injection d'une quantité dosée de tuberculine dans l'épaisseur même de la peau.

Chez l'espèce humaine à la dose de un centième de milligramme, les résultats de cette injection ont été absolument démonstratifs pour la révélation des cas de tuberculose latente, de tuberculose douteuse ou de tuberculose avérée; car, dans les quelques rares cas où l'épreuve est restée sans effets, il s'agissait de sujets en état de cachexie ou de consomption.

Il devenait dès lors intéressant de transporter cette épreuve dans le domaine des animaux, pour voir si expérimentalement les effets seraient comparables, et si pratiquement il y avait quelque bénéfice à en retirer pour les cas de tuberculose latente chez les différentes espèces.

Dans ce but, nous nous sommes attachés à déterminer d'abord les effets de l'épreuve chez des animaux de l'espèce bovine déjà reconnus antérieurement sûrement tuberculeux et chez des sujets reconnus aussi sûrement sains.

Lorsque dans ces conditions on injecte dans l'épaisseur du derme† de $\frac{1}{10}^{e}$ à $\frac{1}{5}^{e}$ de centimètre cube de tuberculine brute diluée à $\frac{1}{10}^{e}$ dans l'eau physiologique ou l'eau distillée, c'est-à-dire de 1 à 2 centigrammes de tuberculine suivant la taille et le poids des sujets, on constate:

1° Que, chez tous les animaux sains sans exception, l'épreuve reste sans effets immédiats et sans résultats éloignés. A peine reste-t-il trace de la piqûre après quarante-huit heures;

* Ch. Mantoux: "Intra-dermo-réaction à la tuberculine" (Comptes rendus de l'Acad. des sciences, 10 août 1908).

† Pour cette injection intra-dermique une seringue de Pravaz de 1 centimètre cube, graduée et munie d'un curseur, suffit; chaque seringue remplie de tuberculine diluée contient 10 doses, ou 5 doses, suivant la taille et le poids des sujets. Une aiguille courte, assez fine, permet aisément de pénétrer directement dans l'épaisseur du derme, si elle est introduite très superficiellement, à fleur de peau. Si par exception elle pénètre dans le tissu conjonctif sous-cutané, sans la retirer, le derme peut être abordé et piqué par sa face profonde.

2° Que chez tous les animaux tuberculeux, au contraire, il se produit à partir du moment de l'injection une réaction locale très vive qui se traduit par de l'augmentation de sensibilité de la peau, *de l'épaississement du derme et l'apparition, durant les quarante-huit heures qui suivent l'injection, d'une plaque circulaire d'œdème sous-cutané dont les dimensions peuvent varier de celles d'une pièce de 5 francs à celles de la paume de la main.* — La réaction, déjà visible après vingtquatre heures, atteint son maximum d'intensité après quarante-huit heures et commence à régresser à partir du troisième ou du quatrième jour; sa disparition est très lente, et chez certains sujets la modification locale est parfois encore tres appréciable après une dizaine de jours.

Chez les sujets à peau non pigmentée (bêtes bovines de races charolaise et nivernaise, par exemple), la réaction s'accompagne ordinairement de l'apparition d'une petite plaque hémorragique intra-dermique qui est d'abord rouge franc, puis rouge brun, puis légèrement violacée vers la fin, et dont les dimensions varient de celles d'une lentille à celles d'une pièce de 50 centimes ou de 1 franc. Cette plaque prend naissance autour du point de piqûre comme centre, sur la partie culminante de la zone œdémateuse qui caractérise la réaction.

Tout autour de la plaque œdémateuse de réaction locale, la peau a conservé sa souplesse ordinaire; ce qui permet par palpation comparative d'apprécier très facilement l'étendue et l'intensité de la réaction locale.

Chez les sujets sains, la peau conserve toujours sa souplesse normale, même au niveau du point d'injection; de sorte que pour un vétérinaire ou un médecin l'appréciation d'une réaction positive ou d'une réaction négative peut être faite d'emblée, sans éducation spéciale à ce point de vue.

Cette réaction intra-dermique spécifique peut être obtenue sur un point quelconque de la surface du corps, encolure, épaule ou toute autre région; malheureusement, pratiquée dans ces conditions, elle présente les inconvénients reconnus à la cuti-réaction, et que l'un de nous a déjà brièvement signalés. Lorsque la peau est très épaisse, et que son plissement régulier pour l'exploration par palpation est déjà difficile à l'état normal, l'appréciation de la réaction œdémateuse locale devient plus difficile et pourrait aux inexpérimentés laisser de l'incertitude et des doutes. D'autre part, chez les sujets à peau pigmentée, qui forment la bien grande majorité de nos races bovines françaises, la tache hémorragique centrale ne peut pas se voir. Il y a donc là quelques petits inconvénients très réels, qui sont à peu près de même nature que ceux reprochés à la cuti-réaction, et qui pourraient arrêter l'application pratique du procédé.

Aussi nous sommes-nous efforcés, non pas de modifier la technique d'épreuve, mais bien de chercher une région d'élection pour l'injection intra-dermique.—Cette région, nous l'avons découverte sans trop de difficultes, et les résultats de l'opération deviennent alors tellement faciles à apprécier

qu'ils peuvent être reconnus par les personnes les plus ignorantes et les moins averties.—Il suffit de voir.

Il existe chez tous les sujets de l'espèce bovine, à la base de la queue, et allant de cet appendice à la marge de l'anus, deux plis cutanés latéraux, au niveau desquels la peau est très fine, très souple, non recouverte de poils et pourvue d'un tissu conjonctivo-élastique sous-cutané très abondant.

Lorsque l'injection intra-dermique de la tuberculine (2 à 4 gouttes de tuberculine à 1, 10e), est faite dans l'un de ces plis, de préférence à la partie supérieure ou moyenne, la réaction se fait identiquement semblable à celle d'une autre région de la peau, si elle est positive; et reste sans effet aucun si elle doit être négative. Vingt-quatre heures après l'épreuve, le résultat est déjà très net et très facilement appréciable, mais là encore le maximum est atteint vers la quarante-huitième heure. Si ce résultat est positif, il suffit de soulever légèrement la queue pour constater que le *pli sous-caudal soumis a l'épreuve a doublé ou triplé d'épaisseur*, alors que l'opposé est reste exactement ce qu'il était au debut.

La comparaison des deux plis saute aux yeux, le resultat est fidelement enregistre pour tous.—D'ordinaire, l'infitration œdémateuse du pli sous-caudal prend une forme ovoïde au niveau du point de piqûre de l'aiguille, pour atteindre les dimensions d'une noisette, d'une amande ou d'une noix; dans d'autres cas, l'infiltration descend dans la hauteur du pli cutané le transformant en bourrelet allongé.

Et si enfin l'injection a été faite un peu trop bas, l'infiltration œdémateuse gagne latéralement et du côté correspondant la marge de l'anus, donnant à cet orifice un aspect un peu déformé et dévié. *La palpation du pli sous-caudal en état de réaction, par comparaison avec le pli opposé normal, donne la sensation tres nette d'une infiltration cutanée et sous-cutanée* dont la sensibilité varie quelque peu avec les sujets.—A partir du quatrième jour, la réaction entre en décroissance, la tension des tissus diminue lentement, mais elle peut rester visible durant une quinzaine, pour une personne habituée.

Chez les sujets non tuberculeux, l'injection reste sans effets, les deux plis cutanés conservent leur aspect primitif leur souplesse et leur mobilité. La palpation comparative ne révèle rien, sinon une petite induration du volume d'un grain de blé, au niveau de la piqûre, mais qui disparaît très rapidement alors que la réaction positive persiste.

Bien que la région d'injection soit une région exposée à de multiples souillures, nous avons toujours fait ces injections sans antisepsie locale préalable, et nous pensons que dans la pratique il n'y aura aucun inconvénient à opérer ainsi; le nombre de nos inoculations nous paraissant assez élevé pour l'affirmer.

En somme, sans qu'il soit besoin de savonner, de raser, de frotter ou de

scarifier, on peut avec une très grande rapidité et une très grande sureté, ainsi que nous le signalerons plus loin dans le tableau de notre statistique, déceler l'existence des tuberculoses latentes ou cachées par un procédé extrêmement simple, qui fait du même coup disparaître les multiples précautions et obligations soit de l'injection sous-cutanée de tuberculine, soit des ophtalmo et cuti-réactions.

Chez quelques sujets ayant réagi de façon positive, mais non chez tous, il se produit parfois au niveau du point de piqûre une petite escarre superficielle des dimensions d'une pièce de 50 centimes ou de 1 franc. L'escarre apparaît au bout de cinq à six jours, sous forme d'une petite croûte brune qui se détache lentement en dix à quinze jours.

RÉSULTATS DES INJECTIONS INTRA-DERMIQUES DE TUBERCULINE CHEZ LES BOVIDÉS.

Races.	Adaptation.	Réaction à l'Injection Intradermique.	Controle de la Réaction Précédente par l'Injection Sous-cutanée.	Autopsie.
No. 1. Génisse charolaise, 2 ans. Reconnue tuberculeuse par injection souscutanée de tuberculine en mai 1908.	Bête d'expérience.	R. positive très nette (4 août 1908).	R = 2°,5. (12 août 1908).	Tuberculose des ganglions rétro-pharyngés et bronchiques. Pas d'autres tubercules visibles ailleurs.
No. 2. Vache bretonne, 4 ans. A reçu sous la peau de la tuberculose humaine qui a fait des lésions locales.	Bête d'expérience.	R. positive très nette (4 août 1908).	R = 1°,4. (12 août 1908).	Simples lésions locales sous-cutanées aux points d'inoculation. Pas de lésions ganglionnaires ou viscérales.
No. 3. Taureau normand, 4 ans. A reçu sous la peau de la tuberculose humaine qui a fait des lésions locales.	Bête d'expérience.	R. positive modérée (4 août 1908).	R = 1°,1. (12 août 1908).	..
No. 4. Vache hollandaise, 7 ans. Œsophagite ancienne guérie.	Sujet de clinique.	R. négative (4 août 1908).	R = nulle. (12 août 1908).	..

RÉSULTATS DES INJECTIONS INTRA-DERMIQUES DE TUBERCULINE CHEZ LES BOVIDÉS. —(*Continued.*)

RACES.	ADAPTATION.	RÉACTION À L'INJECTION INTRADERMIQUE.	CONTROLE DE LA RÉACTION PRÉCÉDENTE PAR L'INJECTION SOUS-CUTANÉE.	AUTOPSIE.
No. 5. Bœuf charolais, 7 ans. Diarrhée chronique.	Sujet de clinique.	R. négative (4 août 1908).	R = 0°,4. (12 août 1908).	Pas de lésions tuberculeuses. Lésions intestinales de diarrhée chronique, lésions athéromateuses de l'endocarde et de l'aorte, ganglions intacts.
No. 6. Vache normande, 6 ans. Arthrite du grasset.	Sujet de clinique.	R. négative (4 août 1908).	R=0°,4 (12 août 1908).	Arthrite plastique du grasset droit. Pas de tuberculose.
No. 7. Génisse race de Salers, 2 ans. Tuberculose expérimentale.	Sujet d'expérience.	R. positive (8 août 1908).	..	..
Nos. 8, 9, 10, 11, 12, 13. Sujets de race de Salers, 2 ans. Tuberculose expérimentale.	Sujets d'expériences.	R. positive chez tous (8 août 1908).	..	..
No. 14. Vache normande âgée. Reconnue tuberculeuse depuis longtemps, par des injections répétées de tuberline.	Sujet d'expérience.	R. positive mais modérée (8 août 1908).	..	..
Nos. 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34.	Bêtes laitières en plein état de ren-	No. 19. Vache flamande âgée. Réaction positive. No. 23. Vache hollandaise âgée. Réaction positive. No 32. Vache hollan daise âgée. Réaction positive.	R. positive 41°,3 38°,6 R = 2°,8 (18 août 1908).	

Résultats des Injections Intra-dermiques de Tuberculine chez les Bovidés — (*Continued.*)

Races.	Adaptation.	Réaction à l'Injection Intradermique.	Controle de la Réaction Précédente par l'Injection Sous-cutanée.	Autopsie.
Vaches laitières en état de rendement et appartenant aux trois races normande, flamande et hollandaise.	dement et en parfait état d'embonpoint.	Baisse modérée de la quantité du lait le 2e jour seulement. Toutes les autres sans exception ont donné un résultat négatif. (14 août 1908).	..	..

Sur 20 vaches laitières, trois réagirent nettement, une seule présenta une diminution appréciable de lait et une température de 39°. L'opération d'inoculation n'a pas demandé plus de 30 minutes pour les vingt bêtes et le relevé du résultat pas plus de cinq minutes pour l'ensemble.

Nos. 35, 36, 37, 38, etc. à 70. Bœufs de travail de 9 à 1200 kilos; de 5 à 10 ans tous de race charolaise, et tous en excellent état d'embonpoint. Il y a eu en 1905 des cas de tuberculose dans l'étable. Aprés tuberculinisation tous les animaux ayant réagi et même les suspects furent réformés et remplacés par des sujets sains. Les animaux ne séjournent pas en moyenne plus de 4 à 5 ans dans l'exploitation. La totalité des inoculations n'a pas demandé plus d'une minute par bête, et l'examen des résultats pas plus de dix minutes pour l'ensemble.	Sur ce total de 36 bœufs, six animaux réformés pour usure sont préparé pour la boucherie. Tous les autres sont en plein service de travail régulier.	No. 47. Réaction trés nette. (14 août 1908). Sur toût l'effectif, un seul réagit positivement, et il est intéressant de signaler que c'est l'un des rares survivants de l'époque où l'étable avait été épurée en 1905.	R. positive. 41°,5 38°,9 R = 2°,6	L'abatage des six animaux préparés pour la boucherie démontra que aucun d'eux n'était atteint de tuberculose. L'abatage du sujet ayant réagi décela des lésions très faibles du poumon et des ganglions bronchiques.

Espèce porcine. — Chez les animaux de l'espèce porcine, on n'avait pas jusqu'à ce jour signalé de moyen réellement pratique de déceler la tubercu-

lose. On a bien dit et démontré que l'injection de tuberculine pouvait donner des résultats identiques à ceux obtenus pour l'espèce bovine; mais vraiment il s'agit d'animaux par trop indociles pour qu'on puisse facilement enregistrer les réactions thermiques par le thermomètre et recourir à ce moyen

L'ophtalmo-réaction n'est pas non plus facile à exécuter, et il est encore plus délicat d'en enregistrer les résultats.

Quant à la cuti-réaction, elle n'a pas non plus à notre connaissance été utilisée dans un but pratique.

Cependant, si la tuberculose porcine n'est pas inscrite dans notre loi sanitaire, on ne peut nier que, pour les éleveurs, il n'y ait parfois un très gros intérêt à savoir s'ils ont ou non de la tuberculose, et s'ils en ont beaucoup ou peu dans leurs exploitations.

Lorsqu'un premier cas par exemple a été découvert dans une porcherie, et que de nombreux animaux ont vécu en commun, ou ont été nourris de façon identique, ce qui arrive très souvent, il y aurait intérêt immédiat à savoir quel est le nombre des tuberculeux pour s'en débarrasser aussitôt d'un seul coup. Le porc est un animal qui peut être consommé à tout âge, qui peut être sacrifié sans pertes appréciables quel que soit son poids; il est donc utile en toutes circonstances de pouvoir découvrir les tuberculeux pour les éliminer sans délais.

Or, ici, notre méthode d'intra-dermo-réaction nous a été d'application relativement facile, étant donné ce que nous connaissions pour l'espèce bovine.

Nous avons utilisé l'injection de $\frac{1}{10}^{e}$ de centimètre cube de tuberculine brute diluée $\frac{1}{10}^{e}$ pour des animaux de tous poids, depuis 20 kilogrammes jusqu'à 150 à 160 kilogrammes.

Après exploration méthodique des régions qui nous paraissaient préférables pour ces injections, nous avions tout d'abord porté notre choix sur la région cutanée située immédiatement en arrière de l'oreille. Là même chez les animaux gras, la peau forme quelques plis qui conservent toujours assez de souplesse et d'elasticité pour une pareille épreuve.

Après quelques essais, et même des résultats positifs absolument démonstratifs, nous avons estimé, pour que la réaction positive fût plus visible et plus facilement appréciable, qu'il valait mieux faire l'inoculation sur la base même de l'oreille, là où la peau a conservé encore assez de mobilité.

La technique de l'injection se fait exactement de la même façon que pour l'espèce bovine, et sans trop de difficultés, bien qu'elle soit plus délicate en raison de la très faible épaisseur du derme.

Seule l'indocilité des sujets est un obstacle à la rapidité d'action.

Cependant, c'est encore là un détail d'ordre secondaire. Pour les animaux adultes ou de gros poids, nous les faisons simplement immobiliser en

position debout suivant le procédé signalé depuis longtemps par l'un de nous,* procédé qui consiste tout simplement à passer une longe en nœud coulant en arrière des canines sur la mâchoire supérieure, et à amarrer cette longe à un anneau ou un poteau. Si l'on opère le long d'un mur, l'animal reste le long du mur, tire modérément en arrière, et l'opérateur peut agir tout à son aise sans craindre des mouvements de défense. Pour les petits animaux, on peut faire immobiliser à volonté en position debout ou en position couchée.

Lorsque dans ces conditions on soumet à l'épreuve des animaux sains, il ne reste pas trace de l'inoculation, il n'y a pas de modification de l'état général, et dans les jours qui suivent on ne découvre même plus le point de piqûre.

Lorsque au contraire il s'agit d'animaux tuberculeux, à quelque degré que ce soit, il se produit au niveau de l'inoculation, parfois immédiatement après ou dans les heures qui suivent, toujours en moins de vingt-quatre ou quarante-huit heures, une tache circulaire rouge vif d'abord, rouge brun dans la suite, puis violacée plus tard. Cette tache, des dimensions primitives d'une tête d'épingle, puis d'une lentille, puis d'une pièce de 50 centimes ou de 1 franc, n'est pas due, comme on pourrait le croire, à une piqûre de veinule sous-cutanée s'accompagnant d'une petite infiltration sanguinolente progressive des tissus; elle est la caractéristique objective primitive de la réaction. — Elle s'accompagne d'ailleurs, comme chez les bovidés, d'une infiltration œdémateuse intra-dermique et sous-cutanée des dimensions d'une noisette ou d'une amande.

Au niveau de la nuque, en arrière de la base de l'oreille, cette infiltration reste très facilement appréciable par la palpation; mais sur la base de l'oreille elle-même elle devient si facilement visible, elle se détache si nettement des parties avoisinantes, qu'il n'y a même plus besoin de toucher. La seule comparaison des sujets sains et des sujets ayant réagi donne une certitude.

Là, elle se montre sous forme d'un œdème en macaron qui surplombe les régions avoisinantes et s'en détache nettement.

La plaque œdémateuse est généralement entourée d'une aréole rosée dont les dimensions peuvent dépasser celles de la paume de la main et gagner toute la base de l'oreille.

La réaction commence d'ordinaire à diminuer d'intensité dès le troisième jour et elle s'atténue rapidement pour l'infiltration œdémateuse; mais la tache hémorragique peut-être encore visible le quinzième jour.

Il ne faudrait pas, bien entendu, au moment de la pratique de l'injection intra-dermique de tuberculine, fausser l'épreuve en piquant directement sur une veinule de l'oreille. Ce qui serait d'ailleurs très facile à apprécier parce que des gouttelettes de sang viendraient sourdre à l'orifice de piqûre. Cet

* Moussu: "Les Maladies du Bétail."

accident ne doit pas arriver, et suffirait à indiquer qu'il faut recommencer l'épreuve en un autre point.

Les animaux ne sont pas indisposés: l'opération en elle-même exige à peine deux à trois minutes pour chaque sujet, juste le temps nécessaire pour l'immobilisation, et, pour ce qui regarde la constatation des résultats elle peut être faite à volonté à partir de la trentesixième heure jusqu'à la quarante-huitième heure et même durant les jours qui suivent. Le simple examen des animaux à distance, et encore mieux la palpation pour plus de certitude, donnent immédiatement une conviction.

Comme pour les animaux de l'espèce bovine, il n'est aucun besoin de prendre des températures, d'immobiliser longuement les sujets, de venir à de multiples reprises les inquiéter, les manipuler ou les explorer; rien de tout cela n'est nécessaire. La constatation du résultat peut être appréciée en quelques minutes chez un grand nombre d'animaux, parce qu'elle est visible, parce qu'elle saute aux yeux de l'homme le moins averti.

Pour les animaux de l'espèce porcine, nous estimons qu'il y a là un procédé très nouveau et qui donnera toute satisfaction jusqu'à découverte plus perfectionnée s'il est possible, puisque aucune des méthodes jusqu'ici utilisées n'avait réellement de valeur pratique.

Cependant, il nous faut noter que chez les sujets à peau pigmentée et à oreilles noires (races de Berkshire par exemple, et variété porcine de Saint-Yriex en France; ou leurs produits de croisement) la réaction positive telle que nous la signalons serait beaucoup plus difficile à apprécier. La vue ne permettrait plus seule d'en voir la modalité et l'intensité, il faudrait forcément recourir à l'appréciation par palpation manuelle. Cette dernière peut parfaitement suffire, en dehors de tout caractère objectif, parce qu'elle est toujours très caractéristique et très nette. Il y aurait d'ailleurs la ressource de chercher un autre point de la surface du corps où la peau ne serait pas pigmentée. Et ce sont là des conditions qui ne représenteront jamais que des exceptions.

ÉPREUVE DE L'INTRA-DERMO-RÉACTION CHEZ LES PORCS.

Numéros.	Épreuve à l'intra-dermo-réaction.	Autopsie.
No. 1. Porcelet de 3 mois. A séjourné avec un sujet à infection purulente. A reçu des cultures de rhumatisme (?) Sujet d'expériences.	Pas de réaction.	Pas de tuberculose.
No. 2. Porcelet de 3 mois, ayant présenté des signes de broncho-pneumonie, guéri.	Pas de réaction.	..

Épreuve de L'intra-dermo-réaction chez les Porcs.—(*Continued.*)

Numéros.	Épreuve à l'intra-dermo-réaction.	Autopsie.
No. 3. Porcelet de 3 mois environ, atteint d'ictère.	Pas de réaction.	Hépatite. Pas de lésions de tuberculose.
No. 4. Verrat d'un an, en séjour dans une porcherie infectée de tuberculose.	Réaction positive très nette (injection en arrière de l'oreille).	..
No. 5. Verrat de 6 mois, même porcherie.	Réaction nulle.	..
Nos. 6, 7 et 8. Jeunes truies de 6 mois destinées à la reproduction.	Réaction positive modérée pour le no 6. Réaction nulle pour les nos 7 et 8.	..
No 9. Porc gras prêt pour l'abatage.	Réaction positive très nette.	Tuberculose des ganglions sous glossiens, bronchique droit et hépatique. Quelques nodules tuberculeux, dans le foie ganglions mésentériques indemnes.
No. 10. Truie nourrice âgée de 2 ans.	Pas de réaction.	..
Nos. 11, 12, 13. Truies réformées âgées de 2 ans.	Réaction positive sur toutes.	..
No. 14. Porc âgé de 6 mois.	Réaction négative.	..
Nos. 15, 16, 17, 18, 19, 20, 21, et 22. Jeunes porcs de 5 mois.	Réaction négative pour tous.	..
No. 23. Truie âgée de 8 mois, en gestation.	Réaction positive.	..

Chèvres et moutons.— Bien que l'on ait assez rarement à enregistrer et surtout à rechercher la tuberculose de la chèvre, et encore moins celle du mouton, il nous a paru utile, nos ressources de laboratoire nous le permettant, de préciser ce que donnerait chez ces animaux l'intra-dermo-réaction.

Chez des chèvres à tuberculose spontanée et à tuberculose expérimentale, nous avons tout d'abord opéré comme chez les bovidés, c'est-à-dire par inocu-

lation intra-dermique en un point de la surface du corps—(région de l'épaule) et ensuite par inoculation dans un pli sous-caudal.—Les résultats sont, peut-on dire, exactement calqués sur ceux que l'on voit apparaître et évoluer chez les bovidés. Dans l'épaisseur de la peau de la surface du corps, la tuberculine à la dose de 1 centigramme, diluée à $\frac{1}{10}^{e}$, donne au bout de quarante-huit heures une plaque œdémateuse circulaire, au niveau de laquelle la surface cutanée apparaît en saillie sur les régions avoisinantes et donne au toucher la sensation d'une région modérément douloureuse et infiltrée. Le plissement cutané ne peut plus se faire, alors qu'il est très commode sur le pourtour, permettant ainsi d'apprécier les différences de caractères. Nous n'avons pas vu se développer de plaque rouge au niveau du point de piqûre, peut-être simplement parce que nos animaux étaient de robe foncée et avaient une peau pigmentée.

Dans le pli sous-caudal, l'injection de la même dose de tuberculine provoque comme ailleurs, dans les quarante-huit heures qui suivent, une réaction très vive qui se traduit par de l'infiltration œdémateuse de toute la hauteur du pli, de la moitié de surface sous-caudale correspondante, et quelquefois même de la totalité de la face inférieure de la queue, si l'injection a été faite un peu haut dans l'épaisseur du pli. La peau prend généralement une teinte rosée légère, comme dans un début d'engorgement érisypélateux, et à la palpation la sensation est très différente de celle de l'état normal. Chez les chèvres et les moutons, en effet, la peau est tellement fine, et le tissu sous-cutané tellement souple, que le plissement cutané dans la région sous-caudale donne une sensation très spéciale, qui diffère totalement de celle recueillie sur la même région lorsqu'elle est œdémateuse. — Il nous a semblé que la disparition de la réaction se faisait plus rapidement que chez les bovidés ou les porcins, car vers le cinquième ou sixième jour cette réaction, dans nos observations, était presque totalement éteinte.

Nos observations ne sont qu'au nombre de dix, il est vrai, et nous n'avons non plus jamais observé la formation d'escarres, pas plus chez la chèvre que chez le mouton.

EPREUVES DE L'INTRA-DERMO-RÉACTION À LA TUBERCULINE CHEZ DES CHÈVRES ET DES MOUTONS.

Espèce.	Adaptation.	Réaction à l'Injection Intradermique de Tuberculine.	Réaction à l'Injection Sous-cutanée de Tuberculine.	Autopsie.
No. 1. Bouc âgé de 3 ans, ayant subi des injections sous-cutanées de tuberculine humaine.	Animal d'expérience.	R. positive (4 août 1908).	R. positive de 39° à 40°:7 R. 1°,7 (12 août 1908).	..

Épreuves de l'intra-dermo-réaction à la Tuberculine chez des Chèvres et des Moutons.—(*Continued.*)

Espèce	Adaptation.	Réaction à l'Injection Intra-dermique de Tuberculine.	Réaction à l'Injection Sous-cutanée de Tuberculine.	Autopsie.
No. 2. Bouc âgé de 5 ans. A subi des tentatives de vaccination par cultures *in vivo* dans le péritoine.	Animal d'expérience.	R. négative (4 août 1908).	R. de 0°,6 (12 août 1908).	..
No. 3. Bouc âgé de 2 ans. A vécu avec une chèvre morte tuberculeuse. (Amenée à la clinique bovine).	Animal de clinique.	R. positive (4 août 1908).	R. positive 40°,7 — 39°,2 R = 1°,,5 (12 août 1908).	..
No. 4. Chèvrette de 18 mois, fille de chèvre morte tuberculeuse.	Animal de clinique.	R. positive (4 août 1908).	R. positive 41°,5 — 39°,2 R = 2°,3 (12 août 1908).	..
No. 5. Brebis southdown, âgée de 5 ans. A reçu sous la peau des bacilles de tuberculose humaine.	Animal d'expérience.	R. positive très forte.	..	..
Nos. 6 et 7. Agneaux atteints de cénurose.	Sujets de clinique.	R. nulle.	..	Cénurose pas de tuberculose.
Nos. 8 et 9. Agneaux atteints de strongylose gastro-intestinale.	Sujets de clinique.	R. nulle.	..	Strongylose, pas de tuberculose.
No. 10. Agneau sain.	Sujet d'expérience.	R. nulle.	..	..

En résumé, l'intra-dermo-réaction à la tuberculine nous a semblé être chez les animaux une épreuve d'une sensibilité parfaite, avec l'avantage énorme de pouvoir être appliquée sans difficulté à toutes les espèces domestiques.

Basée sur l'injection d'une quantité dosée de tuberculine, que l'on sait devoir être forcément absorbée par l'organisme, puisque cette injection se fait dans l'épaisseur des tissus vivants, elle a tous les avantages de l'injection

sous-cutanée sans présenter les inconvénients qui se rattachent aux autres procédés, en particulier à l'ophtalmo-et à la cuti-réaction.

L'ophtalmo-réaction, cela est établi aujourd'hui, peut exposer à des erreurs assez nombreuses; elle peut être gênée et empêchée par un larmoiement exagéré qui balaie la tuberculine, alors qu'il ne s'agit cependant que d'une simple sensibilité individuelle; elle peut paraître positive chez des sujets non tuberculeux dont l'irritabilité conjonctivale est exagérée; et elle a enfin l'inconvénient énorme d'agir sur un organe extrêmement délicat, dont on hésite toujours à troubler le fonctionnement régulier. Si l'on ajoute à ces données ce dernier fait qu'une conjonctive intense consécutive à une épreuve de tuberculine n'est pas par elle-même caractéristique, mais qu'il faut en plus pour que la réaction soit considérée comme positive, que l'inflammation conjonctivale, d'après certains auteurs, aboutisse à la suppuration, on saisit sans peine toutes les difficultés d'interprétation de la réaction oculaire.

Pour ce qui est de la cuti-réaction, qu'elle soit recherchée par frottement à la tuberculine sur une surface récemment rasée, comme l'a indiqué Ligniè-res, ou par scarifications, elle présente toujours d'assez nombreux inconvénients déjà signalés par l'un de nous.*

Si la peau est trop fine ou trop épaisse, si les scarifications ne sont pas proportionnées à l'épaisseur de cette peau, si le suintement consécutif est plus ou moins abondant, si la peau est pigmentée, les résultats obtenus peuvent varier. Il est facile de comprendre d'ailleurs qu'il s'agit d'une épreuve un peu incertaine dans ses effets, suivant l'habileté de l'opérateur, puisque la quantité de tuberculine agissante ne peut être dosée et peut varier.

Les recherches faites ont démontré d'autre part, de l'aveu même de l'inventeur de la méthode (Pirquet), que les résultats n'étaient pas toujours ce qu'ils devraient être, et qu'il y avait en somme un pourcentage assez élevé d'erreurs enregistrées.

Enfin, pour ce qui concerne les animaux, si l'ophtalmo-réaction est d'une application relativement facile, elle exige cependant une certaine main-d'œuvre assez délicate; et pour ce qui concerne la cuti-réaction, le seul fait de l'obligation de raser la peau sur une surface déterminée complique l'intervention. — Ces désavantages seraient sans importance, bien entendu, si le résultat devait dans tous les cas être certain; il nous paraît inutile d'insister, l'expérience ayant prouvé le contraire.

D'où il résulte qu'à l'heure actuelle c'est toujours l'injection sous-cutanée de tuberculine, qui, en vétérinaire donne le maximum de certitude dans les résultats obtenus.

Cependant cette pratique a, elle aussi. ses désavantages, et ils sont nom-

* Moussu: Sur la cuti-réaction chez les bovidés tuberculeux (Société centrale vétérinaire, 15 juillet 1907).

breux. Il faut tout d'abord que les animaux soient immobilisés à l'étable pendant au moins deux ou trois jours, ce qui est souvent un gros inconvénient pour des bêtes de travail, des bêtes d'élevage, ou même des bêtes laitières à l'herbage. Il faut ensuite que ces animaux ne soient pas fébricitants, qu'il n'y ait pas de périodes de rut, etc., etc.

Si l'on ajoute à tout cela la besogne énorme et fastidieuse qui incombe au vétérinaire opérateur pour les relevés de température, et pour une rétribution pécuniaire forcément faible, on comprendra sans peine pourquoi l'emploi de la tuberculine n'est ordinairement tenté que dans les exploitations rurales dont l'effectif bétail est suffisant.

Avec l'intra-dermo-réaction il n'est plus question de tout cela, puisqu'il ne s'agit que de provoquer ou non, une *réaction locale* qui exigera un simple coup d'œil pour savoir si elle sera positive ou négative.

Il n'y a plus à redouter que la tuberculine soit enlevée par un larmoiement excessif ou le saignement exagéré de scarifications, il n'y a plus à prendre de relevés de température ou la crainte d'avoir des élévations thermiques tenant à d'autres causes.

Les animaux au pâturage, les animaux de travail, les vaches en périodes de chaleur ou même fébricitantes peuvent sans inconvénients être soumis à l'épreuve; rien n'est changé dans leur manière de vivre, et la réaction locale si elle se produit, n'aura plus besoin d'être enregistrée à heure fixe après un temps donné. L'opérateur aura tout le loisir, entre la trente-sixième et la quarante-huitième heure, et même encore pendant les jours qui suivront, de venir jeter un coup d'œil sur les animaux qu'il aura inoculés.

Au point de vue pratique, nous pensons donc que la main-d'œuvre a été réduite au minimum possible ainsi que les obligations du clinicien. La quantité de tuberculine nécessaire est insignifiante et le temps d'épreuve, pour peu que les animaux soient maintenus par le personnel chargé de leur donner des soins, ne dépasse guère deux minutes par bœuf ou par vache, et deux à quatre minutes par bête porcine.

Ce sont là des avantages que l'on ne saurait nier et qui, nous l'espérons, seront appréciés dans la pratique de la clientèle.

Nous ne voulons pas soutenir aujourd'hui qu'il n'y aura pas non plus d'inconvénients. Aucune méthode n'est à l'abri de reproches, mais nous serons les premiers à les reconnaître et à les signaler dès que le temps et l'expérience nous auront permis de nous faire une opinion à cet égard.

Conclusions.

Les conclusions qu'il nous paraît possible de tirer de cette étude, sont les suivantes;

1° L'intra-dermo-réaction à la tuberculine, telle que nous l'avons définie, s'est montrée, dans nos recherches, d'une sensibilité parfaite pour dé-

celer la tuberculose chez les espèces animales (espèces bovine, porcine, caprine);

2° L'intra-dermo-réaction positive se traduit par l'évolution d'une manifestation locale, caractérisée par l'épaississement du derme, la formation d'une plaque d'œdème (bêtes bovines), et parfois l'apparition d'une tache rouge centrale (espèce porcine);

3° Cette réaction locale ne provoque pas de troubles généraux d'ordinaire, pas de fièvre ou une fièvre très modérée, pas de perte d'appétit pas ou peu de perte de lait. Elle évolue sans que les conditions ordinaires de la vie des animaux soient changées, et sans qu'il soit nécessaire de prendre aucune mesure ou précaution spéciale;

4° Elle n'a aucun des inconvénients des ophtalmo- et cuti-réactions, et présente tous les avantages de l'injection sous-cutanée de tuberculine:

5° Elle réduit au minimum les obligations de l'opérateur, en supprimant toute manœuvre préparatiore ou complémentaire (prises de température, dénudation de la peau, etc., etc.);

6° Elle est applicable à toutes les espèces animales domestiques.

Die Intradermo-Reaktion auf Tuberkulin bei Tieren.—(MOUSSU UND MANTOUX.)

Die Schlusssätze, die wir es für möglich halten von dieser Arbeit zu ziehensind folgende:

1. Die Intradermo-Reaktion auf Tuberkulin, wie wir sie bezeichnet haben, zeigt sich in unseren Untersuchungen vollkommen empfindlich genug, die Tuberkulose bei Tieren (Rind, Schwein, Ziege) zu offenbaren.

2. Die Intradermo-Reaktion ruft eine lokale Veränderung hervor durch Verdickung der Haut, Oedemflecken (in der Rindgattung), und manchmal die Erscheinung eines zentral gelegenen roten Fleckens (in der Schweingattung).

3. Diese lokale Reaktion verursacht gewöhnlich keine allgemeinen Störungen, wenig oder kein Fieber, keinen Appetitverlust, wenig oder keinen Milchverlust.

Sie entwickelt sich ohne Veränderung in den gewöhnlichen Lebensverhältnissen der Tiere und ohne dass es nötig wäre, irgend welche besondere Massregeln zu treffen.

4. Sie hat keine von den Nachteilen der Conjunktival- und Hautreaktionen und bietet alle Vorteile der subkutanen Einspritzung von Tuberkulin.

5. Sie vermindert sehr die Verpflichtungen des Operateurs, da man ohne Vorbereitungs-oder ergänzende Massregeln (Temperaturnehmen, Hautentblössung, u. s. w.) fertig werden kann.

6. Man kann sie bei jeder Art von Haustieren anwenden.

The Intradermo-reaction to Tuberculin in Animals.—(MOUSSU AND MANTOUX.)

The following are the conclusions which we consider possible to be drawn from this study:

1. The intradermo-reaction to tuberculin, as we have defined it, has shown itself in our investigations quite sensitive enough to reveal tuberculosis in the animals (cattle, hogs, goats).

2. The intradermo-reaction betrays itself by the evolution of a local manifestation, characterized by thickening of the skin, edema (in bovines), and sometimes the appearance of a central red spot (in hogs).

3. This local reaction does not usually cause any general disturbance, causes little or no fever, no loss of appetite, little or no loss of milk.

It develops without any change in the ordinary conditions of the life of the animals and without its being necessary to take any measures or special precautions.

4. It has none of the disadvantages of the ocular and cutaneous reactions, and presents all the advantages of the subcutaneous injection of tuberculin.

5. It reduces the obligations of the operator to a minimum, by dispensing with every preparatory or supplementary measure (taking of temperature, denudation of the skin, etc.).

6. It is applicable to every kind of domestic animal.

EAR-TAGGING MARKETED LIVE-STOCK,

AS A MEANS OF AUTOMATICALLY LOCATING DANGEROUS TUBERCULOUS ANIMALS WHICH CONTAMINATE MILK, AND ECONOMIZING THEIR ERADICATION.

By Dr. Burton Rogers,
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Statisticians agree that 10 per cent. of the people in civilized countries die of tuberculosis, and that means at least 160,000 annually in the United States alone. United States published statistics during the past ten years show that over 100,000 tubercular cattle and over 1,000,000 tubercular hogs have been discovered by the Federal veterinary inspectors of this country.

Scientists agree that it would have been impossible for these persons and these animals to have acquired the disease without the entrance of the tubercle bacilli into their bodies. Scientists agree that, except the very rare cases due to heredity and infection through skin wounds, these tubercle bacilli entered by either the mouth or the nostrils or both.

For a long time, and perhaps beginning with the philological need and origin of the word "miasma," scientists have contended, and all the circumstantial evidence which they observed supported it, that the majority of pathogenic microörganisms were inspired from the air through the larynx and trachea directly into the lungs and the alveoli. Indeed, some have said and still maintain that it is the only method by which tuberculosis is contracted under natural conditions. But as an epoch in medical and scientific history, it may yet be proved that practically no disease infections are produced by inspiration into the respiratory tract beyond the larynx, and our former theories on this point may prove to be as fallacious as the theories the post-mortem empty arteries supported before the discovery of the circulation of the blood by Harvey.

Fresh, uncontaminated, pure air is demanded by nature, and it would be hard to conceive of a more perfect ventilating and filtering system than she provides for the purification of the inspired air by the time it reaches the larynx, trachea, lungs, and alveoli. Nature provides a curved course for the air inspired through the nostrils to the larynx, and, in addition, the nostrils are lined by mucous membrane upon which is a cobweb arrangement of cilia, and both are reinforced by a viscid, sticky secretion.

Tuberculous lesions have been found and do exist in animals and men that never did and never will throw off a virulent tuberculous germ. From a strictly sanitary point of view, tuberculous persons and animals, no matter how badly affected, are not dangerous simply because they have the disease. In case the tuberculous germs leave the tuberculous person or animal, the whole danger lies in what becomes of the virulent organisms after they do separate from the tuberculous persons or animals.

To control and eradicate this danger therefore requires a knowledge of how they are thrown off or excreted. It matters not whether the bacilli are forced through without lesions, or whether the pulmonary lymph-nodes transfer them, or whether the tubercles break down—the organisms do reach the alveoli of the lungs.

In milder cases the irritation causes unconscious reflex activity, and, together with pulmonary contraction and expansion, the germs reach the bronchial and tracheal cilia, which carry them to the pharynx, while, in addition to the above, the greater irritation in severer cases results in forcibly and consciously coughing up the organisms to the pharynx.

Up to this point the conditions are practically the same in all animals and man; but from here on the conditions are very different from every point of view. When such material reaches the pharynx of man, he feels that it is injurious to himself, and his reflexes cause him to spit it out. Every bacteriologist knows that this pulmonary material contains tuberculous germs proportionate to the degree of the openness of the disease in that person, and every such person ought to be taught that it is within their will power to collect and effectually destroy every tuberculous germ which they give off in this manner.

But the tuberculous animal, especially the tuberculous cow, coughs up the germs to the pharynx, and the sensation of the pulmonary mass is no different to her than is the "cud" which she brings up in rumination, and reflex action ends in her swallowing it. The organisms pass through the esophagus into one or more or all of the four bovine stomachs, and from there into the intestines. Placing the average amount of feces passed as thirty pounds, microscopical examinations by the United States Bureau of Animal Industry of one random tuberculous animal showed she was passing tuberculous germs at the rate of 35,000,000 daily, or 330 per grain of feces.

How Germs Get into Milk.—One would not stretch one's imagination at all to see cows in some crowded quarters forced to lie down in their own or the manure of some other tuberculous animal, and thus soil their tails, rumps, legs, udders, all of which is by no means uncommon.

Imagine the milker (not much cleaner), with open pail, milking such a cow, and doing so without any attempts having been made to clean off the

manure, especially if the soiled condition is upon the left or non-milking side of the animal. With warm, freshly drawn milk as a culture-medium, imagine a sterile Petri dish, with a diameter of 12 or 13 inches, exposed under the udder of such a cow with the ordinary commotion and for a period equal to the time necessary to milk a cow. A clod of manure falls into the milk-pail, and during the moment it floats, the milker removes it with his fingers, but the little ones he does not bother with or may not see.

Upon such farms there is always the best milk-strainer possible to purchase, for dairymen know people do not want milk with dirt in it. But as perfect as this filter is, it is not a Chamberland bacterial filter. The invisible organic dirt has been washed and dissolved off of the sedimentary, visible, insoluble dirt by the milk and passes through the strainer.

From the above, it will be seen that under present conditions we have absolutely no idea how many bovine tubercle bacilli are being unconsciously consumed with our milk. It is a fundamental principle in science that no absolutely correct conclusion can or should be made concerning any effect, until all of the evidence bearing upon the effect is known. When the bovine tubercle bacillus will experimentally reproduce itself and set up the disease in every other susceptible animal available for experiment; and when circumstantial evidence in a few cases of human tuberculosis points very strongly to tuberculous food animals as the cause; and when all of the positive etiological evidence of other cases of human tuberculosis is not at hand; and until we are sure the bovine tubercle bacillus has not been or is not in our food, can we afford to ignore the scientific and sanitary conclusion that bovine tuberculosis is transmissible to man.

The possibilities of the history of tuberculosis containing an "interesting error," though possibly never to be recognized, are apparent, especially in such a long-time-dormant and slowly progressive disease, where it is impossible to watch the disease process under natural conditions from the time of the primary infection.

Our Dependence on the Farms.—We know our lives are fundamentally dependent upon the farms, but how much our deaths are similarly dependent we do not know, for the farmer has the best of things in the world, and he has never been asked to guarantee the safety of his produce.

But the argument may be set forth that tuberculosis is a city disease, and if the above is true, it ought to be extremely prevalent in rural districts. The prevention and cure of tuberculosis is recognized universally to be best favored by outdoor life and nature, and this is the perpetual environment of the farmer. The farmer is constantly curing himself in creating resisting vitality; yet in spite of this, the Iowa State Board of Control, which was authorized by the State legislature to investigate tuberculosis in Iowa, show in their Bulletin of October, 1904, that 1596 physicians of Iowa re-

ported 3300 cases of consumption, and while the occupations of 429 were not given, and 980 were included in the general term "housewives," there were specified the following among the remainder: 468 farmers, 74 farmers' wives, 33 farmers' daughters, 4 farmers' sons, and 23 farm-hands—or a total of 602 in farm environment.

It is within the will-power of 95 per cent. of the farmers of this country to immediately prove to themselves, and to the whole world, that they are not one of those owning dangerous tuberculous animals. Such a desirable attitude upon the part of 100 per cent. of the farmers who have not already done so would immediately locate all the dangerous tuberculous animals, and thus save the government the expense of locating them in the interests of public health and of the farmers themselves, and with the part of the appropriations thus saved in this manner the unfortunate owners of tuberculous animals could be more fully reimbursed for condemnations and losses.

Tuberculous Meat.—Most meat is heated and cooked sufficiently to destroy the tubercle bacilli, if present; and this fact suggests that the meat of tuberculous animals could be intelligently sterilized. At any rate, scientists advocate the absolute safety of pasteurized tuberculous or suspected milk, and no one can deny that it would be inconsistent not to permit and similarly certify to the greater safety of sterilized non-tuberculous, or even the tuberculous meat of tuberculous food animals. Besides, meat is eaten by adults, but milk is drunk by susceptible babies.

If the recognized facts in science concerning heat and sterilization were applied as advocated here, instead of indefinitely continuing the present practice of condemning and rendering useless the bulk of the animals and their meat, with great losses, these losses could be prevented by giving greater value to the meat, and thus all dangerous living tuberculous animals be encouraged to be marketed immediately and slaughtered.

How to Eradicate.—It shall be the purpose of the rest of this paper to prove how, during the next two years, these dangerous tuberculous animals, as well as the premises from which they came, can be automatically located at nominal cost, and be eradicated (at least intelligently controlled) without cost or loss in excess of present actual losses. Of course, the quickest way to locate every tuberculous animal is to have every one of them, especially cows and bulls, immediately tested with tuberculin by competent, reliable veterinarians.

During the fiscal year 1907, Federal veterinary inspectors discovered 29,835 tuberculous cattle and 430,177 tuberculous hogs among the animals slaughtered. Scientists know that it would have been impossible for these animals to have become tuberculous unless, during their life-time, their atmospheric and other environment or their food contained tuberculous germs which they inspired or ate.

Under present conditions, when these animals are all mixed up, by the time they reach the markets and are slaughtered and inspected it is impossible to know where any animal came from. But if all the animals had been simply tagged with metal ear tags, showing the name and address of the original owner, the tags of an approved type that would remain until the animal was post-mortemed by the inspectors, we would know the premises upon which to make an investigation of the cause.

Let us take the tuberculous hogs alone. Most hogs, except parents, are slaughtered when less than one year of age, and this means that within the past year these hogs have been exposed to contaminating conditions that produced the disease in its varying degrees. The following methods are now recognized as the most common ways in which these hogs acquired the disease, and if there are any additional ways not yet discovered or known, it is incontestable that these are the farms upon which to investigate and find out.

First, and from every point of view, the most important mode of infection is by following tuberculous cattle. Many cattle are followed by hogs and associated with them in the same pens for varying lengths of time. Hogs are also put into pens, stables, and quarters after cattle have been taken out.

Now, keep in mind the manner in which dangerous tuberculous cattle give off their germs in the feces. Agricultural economy in animal husbandry has proved that it is profitable to have omnivorous hogs secure a part of their ration from the partially nutritious droppings of cattle, especially if the cattle are overfed and undigested food passes through with the feces. Therefore, hogs are encouraged to, and do satisfy their voracious appetites by snooting and rooting in and devouring the droppings of feces of cattle, and as a result become tuberculous proportionate to the degree of their individual resistance and the numbers of virulent tubercle bacilli in the feces.

All these animals test the degree of dangerousness of the environment to which they were exposed, and of the food which they ate. The environment and similar food is still left for other hogs and man and babies. No more accurate and finer feeding test could be purposely arranged for and conducted by scientists than this one going on naturally—yet no advantage is being taken of it.

And what evidence is there to support this?

In the summer of 1904, while a Federal veterinary inspector in an Iowa town, the writer tagged 3430 of the hogs that were brought to the packing-house in individual wagons by the individual farmers within a radius of 20 miles. These hogs were slaughtered separately from car-load lots of shipped-in hogs, and during the experiment only 39 of the 626 different farmers in an exceptionally bad tuberculous district brought in all of the tuberculous hogs.

Last winter (1907–08) the assistant State veterinarian stated that in testing the cattle upon only 15 of the farms from which tuberculous hogs came, he found tuberculin-reacting cattle in every instance. The others would no doubt be the same.

Last winter the experiment station at Ames, Iowa, knowingly and purposely forced 28 healthy pigs to follow non-reacting tuberculin-tested, and therefore healthy, cattle in the same feed lot or pens; and likewise forced 20 other healthy pigs to follow cattle that had reacted positively to the tuberculin test, and were therefore tuberculous. A few months later the hogs were slaughtered and inspected, and none of those following the healthy cattle were tuberculous, while 21 out of the 28 following the tuberculous cattle were tuberculous.

Not only did the tuberculin, but so did the hogs test the cattle. And so did the 430,177 tuberculous hogs condemned by Federal inspectors test similar conditions on unknown farms.

If the degree of tuberculosis in the hogs is proportionate to the number of virulent tubercle bacilli in the feces eaten by the hogs, then the degree of the dangerousness of the milk (and its final products unconsciously consumed by man) is similarly proportionate when contaminated with these same feces. When practically every one of the five or six million farms of this country have hogs following and associating with the cattle; and when practically every farmer markets one or more hogs every year; and when the bulk of these hogs go to packing-houses where two thorough post-mortem examinations are made for tuberculosis of every hog killed—it is undoubtedly desirable to have every hog going to market tagged, either voluntarily or by law, so that we can locate these few premises that are a menace to the health of our people, especially of the children and babies, who must drink milk from such sources as are described here. These few farms are blighting the whole live-stock industry and its products.

Science has previously erred in giving prominence to the assumption that tuberculous cows secrete tuberculous milk, and (unconsciously) ignored the more important sanitary fact that tuberculous animals, both male and female, may manifestly to a greater degree contaminate milk with bovine tubercle bacilli.

Then what shall be done after the location of the tuberculous premises?

In every instance all the cattle upon the place should be immediately tested with tuberculin by an honest, reliable veterinarian, and preferably an official one. Tuberculin will nearly always indicate the tuberculous and the non-tuberculous, so that they can be separated from each other. Tuberculin, while it is recognized that no diagnostic agent for any purpose excels it in accuracy, has proved not to be absolutely infallible, and therefore the results of the tuberculin test need not or should not be considered wholly reliable in itself, for the following reasons:

Objections to Tuberculin.—Tuberculin (being the filtered laboratory excrement of the tuberculosis germ when grown in culture-media, and when the regular and generally most satisfactory dose is only 2 c.c. of the diluted standardized tuberculin) may be injected into an animal which has already within its system such a large quantity of natural tuberculin manufactured by the tuberculous germs in immense numbers in its system, the 2 c.c. is without the characteristic effect, if any at all. Such animals usually show marked physical and clinical evidence of the disease, but some animals, especially bulls of very strong vigor and vitality, may withstand, up to a certain extent, the physical effects of the disease and its products. Therefore, the unfortunate result is that at times such animals may still be left with the healthy cattle and in the same quarters unconsciously.

Now, on the other extreme, tuberculin is so delicate that it will cause a reaction in animals which have only one little tubercle the size of a pea or less in one unimportant lymph-gland, and reacting animals of varying values have been slaughtered in which not a single lesion could be found at post mortem by expert veterinarians. In such cases the conclusion is generally offered that the tuberculin could not possibly have erred, but that there must exist a lesion somewhere, even though it could not be found, or was overlooked by the expert.

So, after tuberculin has done its duty as far as extreme accuracy is concerned, it would seem advisable to supplement it again, if possible, as a check upon its great delicacy and accuracy for economic, practical, scientific, and real sanitary purposes.

If the animals are extremely valuable, each animal should be constantly, or at least intermittently, kept in a separate pen with one or more young pigs. Or the feces of each animal could be gathered from the regular stall of each animal, and be fed to such hogs, tagged and numbered and kept in small separate pens. The slime from the separators might be fed to hogs or to one hog also.

The hogs should be slaughtered in due time under the supervision of a veterinarian, either by making previous arrangements as to dates, or taken to regular packing-houses. As a result, the degree of the disease in each hog will proportionately determine the degree of the dangerousness of the bovine it followed, or of the feces it was fed.

Some of the hogs may not show any lesions at all, and this means that the tuberculin-reacting bovine with which they have associated or ate the feces of was not giving off, or throwing off, or excreting any tuberculous germs, and this bovine was, therefore, not necessarily dangerous from a sanitary point of view. Such a thing might occur as that only one or two of the tuberculin-reacting cattle might produce the disease in the hogs associating with them and eating their feces, and these hogs may be tuberculous in any degree conceivable.

Thus far this seems to be the best method proposed that will permit of the same important conclusion before death that a post-mortem would reveal. By such a hog-association-test there might be saved to the wealth of the country a large number of animals which are at present destroyed.

Any animal which will produce tuberculosis in hogs by this method of exposure is a dangerous animal, and public health interests can rightfully demand that such an animal shall be destroyed at private or public expense, or at least be so intelligently quarantined or controlled that none of the tuberculous organisms it gives off will ever reach another animal or man in a virulent reproductive condition.

Every intelligent live-stock owner could, no doubt, be easily convinced that, upon the demonstration of one or more such animals in his herd, these animals will, no doubt, finally die of the disease, and in addition to this also cause the disease in and the death of other animals in the herd if he keeps them long enough. And it would be profitable in the long run to dispose of the animals immediately, or at least put them under intelligent control, if they possess other qualities desirable to perpetuate.

As a result, more could be done toward the eradication of dangerous tuberculous animals than has been accomplished during all the twenty-five years of the campaign in behalf of tuberculin as the only method—and this does not disparage the undeniable value of tuberculin.

Pure Food Law.—Upon our statute-books there exists the Pure Food and Drugs Act of June 30, 1906, the spirit and intent of which is that everything, especially that which will be ultimately consumed, shall be sold upon its merits—for what it is; and that it shall be edible and free of disease, and shall not be dangerous or deleterious to health. Therefore, every ounce of meat or meat produce which leaves packing-houses for interstate trade must be labeled "U. S. Inspected and Passed," together with the number and name of the abattoir or packing-house from which it came.

During the fiscal year 1907 alone, of the 50,935,216 live animals coming from the farms of this country and slaughtered and inspected in packing-houses having Federal inspection, 151,772 whole carcasses, and "parts" of 529,876 other carcasses, were condemned; of which whole carcasses 84,991 were tuberculous, and of the parts of carcasses, 375,093 were tuberculous, and were therefore condemned and not allowed for food, although the farmers sold them and the packers bought them for that purpose.

It would seem that the legislation in the Act of June 30, 1906, would be sufficient, if brought to their attention, for the Executive, through the Secretary of Agriculture, who is authorized and responsible for the making and enforcing of regulations upon this law, and backed by the courts, to require at once that all live-stock entering interstate trade shall be tagged with the name and address of the owner, in order that these animals, in the

first place, shall be sold on their merits and be guaranteed by the producer; and, in the second place, if the animals are found to be diseased, that the cause of the condition can be traced back to the farm and located for the purpose of making all dairy produce—the most important of all foods from a sanitary point of view—safe.

Since tuberculosis cannot be immediately recognized or even suspected in the living animal without the use of the individual two-day tuberculin test, then, in order to be sure that tuberculosis does not exist in any animal, it would be necessary to apply the tuberculin test to every animal upon every one of the between five and six million farms of this country. This is very plainly an immense undertaking, and would take several years and an immense sum of money.

Indeed, this might cost more than the government did or could appropriate, and more than the actual value of the tuberculous animals, and besides leave nothing to reimburse the owners for losses and condemnations sustained. This feature always looms up, and influences are brought to bear that retard proposed legislation.

Would it not be far more economical to pass laws prohibiting inter- and intra-state traffic in untagged live-stock, and then furnish the tags, and even the tag fasteners themselves, upon application from the farmers, and provide penalties for attempts to evade the purpose of it? The law would indirectly force them to make application for tags.

Even with such a law, without any appropriations, the present expense of the powerful meat inspection machinery of the United States Bureau of Animal Industry in the Department of Agriculture would bring greater returns from the $3,000,000 annually appropriated, in being able to trace back the source of the tagged hogs that would be found to be tuberculous. But if the government or the farmers would not purchase the tags, it would be profitable for the packers to manufacture or purchase the tags and offer them for distribution to the farmers free upon application. For it must seem reasonable to you to suppose that, if the packers cannot possibly secure buyers or other persons at any price or salary, sufficiently expert to detect or even suspect the 430,177 tuberculous hogs and the 29,835 tuberculous cattle that were unconsciously purchased in 1907 at full market values among the 31,815,900 live hogs and 7,621,717 cattle; the packer would want to coöperate in every way with the farmers and the government toward eradicating the disease.

In conclusion, let us take a definite period of time, for instance. Last September the writer began and has since kept up, in spite of opposition, a vigorous educational propaganda in the agricultural press, advocating the tagging of all marketed live-stock as a means to the end desired, with the hope of getting the farmers, packers, government, and con-

sumer together for the purpose of economized and coöperative effort concentrated toward the eradication of animal tuberculosis. This method of locating infected farms was conceived by me in 1901, although it was not published until 1905.

If the tagging idea had been thoroughly understood and been supported, and if the farmers would have practised what they were convinced was right, and every animal going to market since last September had been tagged, the tuberculous hogs discovered by inspectors would have located practically every farm in this country that has or had tuberculous animals upon it. And upon a large number of these farms the owners would have, for the first time, been brought face to face with the incontestable and tangible, but heretofore unsuspected and unrealized, fact that they needed to do something, and the tuberculin test would then have been conducted.

La Marca Obligatoria de los Animales Tuberculosos como un Medio para Indicar los peligros en la Alimentacion y facilitar la eliminación de éstos.—(Rogers.)

Animales peligrosos con focos de tuberculosis en los pulmones arrojan por medio de la tos los productos tuberculosis á la boca, debido al imperfecto desarrollo psicológico y físico del animal el acto de la expectoracion no es perfecto y los productos de esta son tragados y pasan al aparato digestivo. Mientras que algunos son absorbidos, la mayor parte son descargados con los excrementos, y he aqui el principio del peligro de los animales tuberculosos. Como termino medio 35,000,000 de bacilos por cada día se han encontrado en los excrementos.

El acarreo de animales sanos y la preparacion de los productos de la lecheria en tales lugares ha sido olvidado y no se ha reconocido como un factor en la tuberculosis. Las particulas del estiercol llegan á formar parte del polvo de la atmosfera que se deposita en la leche. Las vacas se ensucian las ubres, el abdomen, la cola, etc. y como consecuencia el bacilo cae sobre la leche durante el ordeño.

Los cerdos al alimentarse del estiercol adquieren un grado de tuberculosis en proporcion á la virulencia del bacilo en los excrementos. La inspección de 31,815,900 cerdos en 1907, demostró la infección de tuberculosis en 430,177. La infección predomina especialmente en los cerdos que estan en contacto con estos establos infectados.

Una marca de metal en la oreja dando la dirección del dueño facilitaría conciderablemente la automatica localizacion de las vacas tuberculosas.

Etiquettage Obligatoire comme Moyen de tracer automatiquement les Animaux tuberculeux dangereux et d'obtenir leur Eradication d'une Manière économique.—(ROGERS.)

Les bovidés dangereux, avec tuberculose *ouverte*, en toussant font passer les organismes de leurs poumons dans la bouche, et leur bas développement psychologique et physique les empêche de compléter l'acte d'expectoration par le crachement, de sorte qu'ils les avalent au lieu de les cracher. Quelques-uns sont absorbés, mais la majorité passe avec les excréments, et c'est là que commence le danger résultant des animaux tuberculeux; en effet on a trouvé une moyenne quotidienne de 35,000,000 de bacilles tuberculeux dans les excréments d'un animal.

L'action de préparer et d'obtenir des produits de laiterie, ainsi que la présence constante d'animaux sains dans un pareil environnement, est un facteur productif de tuberculose jusqu'ici méconnu et ignoré. Des parties minuscules de ce fumier forment part de la poussière des étables, qui tombe dans les seaux à lait chaque jour. Les vaches souillent leurs mamelles, leurs jambes et leurs queues en se couchant dans ce femier, et font tomber cette souillure en différentes quantités dans les seaux à lait ouverts, pendant le trayage.

Les cochons fouillent dans ces excréments, en mangent, et contractent un degré de tuberculose proportionnel au nombre de bacilles virulents qui se trouvent dans les excréments. Des 31,815,900 cochons inspectés en 1907, 430,177 étaient tuberculeux, la majorité ayant contracté la maladie en suivant le bétail tuberculeux dangereux.

Des plaques ou étiquettes en métal, fixées aux oreilles et indiquant l'adresse du premier propriétaire de tous les cochons vendus, traceraient automatiquement les vaches tuberculeuses dangereuses.

Zwangsweise Kennzeichnung als ein Mittel um gefährlich tuberkulöse Futtertiere automatisch einzuschränken und ihre Ausbreitung hinanzuhalten.—(ROGERS.)

Gefährliche Rinder mit offener Tuberkulose husten die Organismen von der Lunge in den Mund, und ihre niedere psychologische und physische Entwicklung verhindert sie, den Expectorationsakt durch Ausspucken zu vollenden; anstatt dessen verschlucken sie dieselben. Ein Teil davon wird absorbirt, die grösste Anzahl geht mit den Faeces heraus; hier beginnt die Gefährlichkeit der tuberkulösen Tiere, da ein täglicher Durchschnitt von 35,000,000 Tuberkelbazillen in den Faeces eines Tieres gefunden wurde.

Die Gewinnung und Bereitung von Meiereiproducten und die constante Anwesenheit von gesunden Tieren in solch einer Umgebung ist ein bisher

nicht anerkannter und übersehener Factor um Tuberkulose zu verursachen. Teilchen von solchem Stallmiste bilden einen Teil des Stallstaubes, der täglich in die offenen Milchgefässe fällt. Die Kühe beschmutzen ihre Euter, Körper und Schwänze durch das Liegen in solchem Miste, und zur Melkzeit fällt er in wechselnden Mengen in die offenen Milchgefässe.

Schweine beschnüffeln und fressen solche Faeces und acquiriren einen Grad von Tuberkulose der proportional ist zu der Anzahl der virulenten Tuberkelbazillen in den Faeces. Unter den 31,815,900 Schweinen, die im Jahre 1907 inspicirt wurden, waren 430,177 tuberkulös; die Mehrzahl davon hatte die Krankheit dadurch erhalten, dass sie solch gefährlich tuberkulösen Rindern gefolgt war.

Metallene Ohrenzeichen, die die Adresse des ursprünglichen Eigentümers aller verkauften Schweine zeigen, würden automatisch gefährlich tuberkulöse Kühe lokalisiren.

DISCUSSION.

Dr. Peters (Nebraska): The antagonism of the farmers to the adoption of satisfactory measures for controlling this disease must be overcome by proper education of the interested farmers. This should play a most important part in the campaign against tuberculosis. Instances are known where loads of cattle have been shipped into the stockyards which were known to be affected with tuberculosis, yet they have not been offered for sale subject to post-mortem examination unless compelled to do so by the State authorities. The presence of the disease in certain localities can be established by an identification system, and any data which can be obtained concerning the presence of the disease on certain farms is of great value in securing funds through State legislatures for the control of tuberculosis. I believe that eventually the tagging system in some form will bring satisfactory results. I believe sooner or later that this identification method will be practicable, and that the various States will take it up. It is one of the commercial problems for us to take up. In my work in Nebraska in coöperation with the Federal Bureau of Animal Industry we located many centers of infection. I can heartily commend this identification method to you, and I am sure it will always be found to bring good results.

Dr. Reynolds: I would like to have Mr. Ferguson given the privilege of the floor in order to tell us what he thinks of this identification method, and also as to its feasibility on a large scale.

Mr. Ferguson (Chicago): This question is of great importance to the packers, but unless you can get the government bureau, the larger commission men and all of the shippers in line you cannot locate centers of infection.

The present identification method is not practicable. Wherever it is applicable, identification can be secured, and the packers are ready at any time to assist the State officials in their efforts to locate the trouble. It is too bad that the matter has been allowed to remain without some effort to remedy it. Unless you can get the commission men to keep a correct record of the cattle handled by them and supply the information to the officials, you will not have much success. These commission men are opposed to the method, and their coöperation is hard to obtain, and unless you can get back to the original farm where the infected stock is found, you will not have much success in cleaning up tuberculosis. This cannot be accomplished without having some method of tracing the animals to the farms from which they come.

Dr. Rutherford: This is a subject in which I am taking great interest. We have had some experience in Canada along the same lines. We found that as soon as we began our meat inspection we had to condemn a large number of tuberculous animals, and there was a great deal of agitation immediately. I found that when we condemned 12 or 15 hogs for a farmer, he was going to look into the matter. I think we can with our efforts probably do something in the way of identification. We already have a system in operation by which our inspectors furnish a certificate to the packer in cases where the animals have been condemned. This certificate is taken back and the money is refunded by the original producer. This question hinges on some definite, legal, effective way of dealing with tuberculous animals on the farms. What is the use of tracing the disease to the farm unless you have some law on which to act? Under existing conditions I want to know what is the use of tracing it up unless you have a legal way of dealing with tuberculosis on the farm.

Dr. Nelson: I have been trying to carry out in the western part of my State the voluntary coöperation of the small butchers in asking them to report to me the source of the diseased animals which he encounters, and even in this small way I have had good results.

Dr. Rogers: I believe that with the aid of a tag which would remain on the hog after going through the scraping machine, the identification of the animal could be accomplished without much difficulty, and this would serve to trace the animal to the infected farm.

SECTION VII.

Tuberculosis of Animals and Its Relations to Man (*Continued*).

SEVENTH SESSION.

Friday, October 2, 1908.

THE CONTROL OF TUBERCULOSIS IN ANIMALS.

Section VII of the International Congress on Tuberculosis was called to order by the president, Dr. Leonard Pearson, at half-past nine o'clock, on Friday morning, October 2, 1908.

MEASURES AGAINST ANIMAL TUBERCULOSIS IN DENMARK.

By Bernhard Bang, M.D.,
Professor of Pathology and Therapeutics, Royal Veterinary School, Copenhagen.
Delegate of the Danish Government.

Measures against tuberculosis among domestic animals were first taken by the State by act of April 14, 1893, relating to the prevention of infectious diseases among domestic animals. According to sec. 11 of this act cattle-owners are prohibited:

(*a*) From sending animals (cattle and pigs) that obviously suffer from tuberculosis, to fairs and cattle-shows, to common pastures, stables, etc., of other cattle-owners, as well as from selling such animals, except for slaughter;

(*b*) From selling or using as human food animals or any part of an animal, obviously suffering from tuberculosis, unless a veterinary surgeon's certifi-

cate be produced stating that a previous examination of the carcass and the entrails has shown the meat to be fit for human consumption;

(*c*) From selling the milk of cows suffering from tuberculosis of the udder or using it as human food or in the preparation of food or as food for animals, except when boiled.

These measures have, however, produced few practical results. It is true that a number of animals have been rejected when presented for admittance at fairs and common pastures or for exportation, and no doubt the sale of such animals for other than killing purposes has now and then been prevented; still, it is difficult to impose fines in such cases, the term "obviously tuberculous" being too vague. Paragraphs *b* and *c* were amended later so as to provide more fully for the cases mentioned in them.

By the act of April 14, 1893, relating to State help toward the combating of tuberculosis among cattle, an attempt was made to encourage cattle-farmers to take measures to get rid of tuberculosis among their stock. By this act a sum of 50,000 kr.* yearly (afterward increased to 100,000 kr.) was, for a term of five years, placed at the disposal of the Ministry of Agriculture to pay for gratis distribution of tuberculin, for the injection of this substance by veterinary surgeons, for measuring the temperature of the animals, and for giving directions as to isolation, if the farmer in question wished to apply the tuberculin test to ascertain which of his animals were infected with tuberculosis, but only on condition of his binding himself to keep the healthy animals safely isolated from those suffering from tuberculosis.

As the primary object of these measures was to promote the breeding of healthy young cattle, at first only young animals were tested gratis; soon, however, the test was also applied gratis in the case of full-grown animals, and gradually it became quite common to subject the whole stock of a farm to the tuberculin-test in order to make it possible to isolate the healthy among the full-grown animals.

The passing of this act was chiefly due to a proposal of B. Bang, who for some years past had been studying the efficacy of tuberculin for proving the existence of tuberculosis among cattle and other domestic animals, and who had worked out a system for the extermination of tuberculosis in an infected stock by thorough isolation of the animals that were not yet attacked and by preventing the transmission of infection through raw milk.

According to Bang, tuberculosis is a purely contagious disease. It is true that infection may take place in the uterus so that the calf is born tuberculous, but this happens very rarely—practically only when the cow is highly tuberculous. Most calves are born healthy, even if born of somewhat tuberculous cows, and they will remain so if they are only preserved from infection. In the first place: tubercle bacilli are not ubiquitous.

* 1 kr. (krone) = 100 ø. (øre) = about 25 cents.

They are mostly found in stables, where tuberculous animals discharging tubercle bacilli are or have lately been stabled. Secondly: raw milk very often transmits infection, mostly, it is true, when the udder of the cow is attacked, but also frequently when this is not the case, partly because tubercle bacilli may be excreted through an apparently healthy udder, if the cow is highly tuberculous, partly because pure milk may be fouled by the introduction of tubercle bacilli through flux of the uterus or by particles of the feces of highly tuberculous cows.

The tuberculin tests proved that a great number of cattle of all the herds among which tuberculosis had long been prevalent were infected with this disease. Post-mortem examinations proved, however, that most of the reacting animals were only slightly affected; in many cases only small caseous-calcareous deposits were found in a few of the lymphatic glands, processes that no doubt often remain unchanged for years or are even sometimes cured.

According to Bang, therefore, there was no reason to kill milch-cows that did not show clinical signs of tuberculosis, but only reaction to tuberculin. So long as they were stabled in isolated stables, there was no reason why they should be killed or why their milk should not be used and calves bred from them, provided the latter were as soon as possible removed from the infected stable and were not infected by being fed on the raw milk of tuberculous animals. The highly tuberculous animals should not, of course, be allowed to form part of the stock, but should be killed as soon as possible—a measure which had certainly been taken rather often in former times, though not nearly as often as circumstances demanded.

It will be seen that these measures—devised by Bang and founded on the above facts—for combating tuberculosis among cattle interfered as little as possible with the breeding. He wanted farmers to remove from their stock only such animals as, from reasons of general economy, they would feel inclined to remove, *i. e.*, the animals that a merely clinical examination proved to be tuberculous. They were allowed to keep those that did not appear tuberculous until subjected to the tuberculin test, as long as they found they yielded sufficient milk, and to breed their calves, if only they took good care to keep the latter isolated from the perfectly healthy animals. If the isolation could not be carried out in any safer way (which would, of course, be preferable), a part of the stable might be partitioned off by a wooden partition, reaching from the ceiling to the floor. The common water-pipe would have to be cut off, or, if this was not practicable, it might be sufficient to let the water pass first through the part of the stable reserved for the healthy animals. If absolutely necessary, it would be permissible to have tight-fitting doors in the partition-wall; though this has certainly often proved a drawback, it being, of course, very difficult to keep such doors shut when not in actual use. Whenever it is at all possible, as it would be in the case of a

large stock, there ought to be two sets of stable hands—one for the healthy animals, one for the infected ones. If this was not possible, the servants would have to tend and milk the healthy animals first and have two sets of boots or shoes and overalls, as well as of implements, one for each class of animal. In the pastures the two divisions would also have to be kept apart as much as possible, though the danger is considered to be less when the animals are grazing than when they are in the stable.

As from the very outset it was quite clear to Bang that isolation of the animals on the same farm, especially if such had to be effected in one building by means of a partition-wall, could not be a complete guarantee against the introduction of contagious matter among the healthy animals, and that the tuberculin test was not in every case quite infallible (for instance, the animals might have been infected just before the test and so be unable to react), he directed that the healthy division was to be subjected to the tuberculin test once—or preferably twice—a year, so that those animals which, in spite of the isolation, proved to be infected, might be removed without delay from the healthy division to the reacting one, his object being the gradual purification of an infected stock during the course of several years. It would thus become possible for a farmer possessing a stock in itself valuable, though infected with tuberculosis, to gradually convert it into a healthy one by breeding from his own stock.

As early as 1892 Bang was enabled by a special government grant to demonstrate the practicability of his theories by gradually changing a highly tuberculous stock into a healthy one. The farm of Thurebylille was selected for this experiment. On the first application of the test 131 animals reacted, while only 77, mostly young animals, were found to be healthy. Of the milch-cows, 80 per cent. reacted, and of the young cattle and calves, only 40 per cent. The isolation of the two classes, the reacting and the healthy ones, from each other was effected by partitioning off a part of the stable with a solid wooden partition, the shed occupied by the calves forming part of the healthy division. There were two sets of stable hands, one for each of the two divisions, which were, moreover, kept apart when grazing as well as in the stable.

The practicability of the plan was soon proved, as the calves which were born in the infected division of reacting parents were nearly all found to be healthy (very few being born tuberculous), and remained so, provided they were at once removed from the infected stable and fed on boiled milk, their mother's milk (raw) only being given to them on the first day.

Still, as had been expected, year by year some of the animals of the healthy division did not pass the half-yearly test; in other words, some infection was introduced into the healthy division in spite of the isolation. Generally, it was only one or a few per cent. that did not pass the test; on a few occasions,

however, it was as much as 9 per cent. It will thus be seen that the elimination of the infection proceeded rather slowly, but then circumstances were rather unfavorable, because the isolation was not a thorough one, the daily control less effective than might have been desired, and, lastly, because the farmer was not sufficiently alive to the importance of removing highly tuberculous animals, discharging great quantities of bacilli, from the reacting division.

In spite of these drawbacks the healthy division increased year by year, and at last the task of eliminating the disease was successfully accomplished by selling the remainder of the reacting division—about 30 head of cattle. The farm is now one of those that supply Copenhagen with "milk for infants" (*i. e.*, superior milk); the stock is every year subjected to the tuberculin test, and the last time, in 1907, not one out of 211 animals reacted.

As the act of 1893 provided generous assistance to such cattle-farmers as were anxious to improve the sanitary condition of their stock by employing the method which had been tried at Thurebylille, a great number of both small and large farmers set to work, in many cases with excellent results. At all large farms, however, where tuberculosis is generally very prevalent, the elimination of infection progressed slowly, just as had been the case at Thurebylille, a few of the animals of the healthy division reacting whenever they were subjected to the test a second time. The stricter the isolation, the better the results, the best results being, of course, achieved, when it was possible to remove the healthy animals to another farm. The thorough disinfection of stables where highly tuberculous animals had been stabled, in order to destroy all contagious matter, often proved a very difficult task, especially in buildings where the woodwork and the stone floors were old and dilapidated. Where tuberculosis was not very prevalent, as was very often the case among small herds, and sometimes even among large ones (in one case, for instance, only 6 animals out of 134 reacted), it was, of course, easy enough to root out the infection completely.

By means of the numerous tuberculin tests which—especially during the first few years after the introduction of Bang's method—were applied to cattle in all parts of Denmark, much valuable information was obtained as to the extent of tuberculosis in Denmark, closely corresponding with the results obtained in all other countries where tuberculin was largely used. In many herds the disease was very prevalent. Among large herds (*i. e.*, herds numbering 50 or more animals), only few proved to be quite free from tuberculosis. Among stocks of this size the average number of reacting animals was 50 or 60 per cent., while among small herds (numbering less than 50 animals) a great number, about one-fourth, were perfectly healthy, and the number of reacting animals in infected "small" stocks was considerably less than that of the large ones—hardly 30 per cent.

The fact that a great many small stocks consist of none but healthy animals (in 1898 there were 2203 stocks, numbering 30,101 animals; on an average, 14 in each) clearly shows that the opinion, prevalent among many medical men, that tubercle bacilli are ubiquitous, is fallacious. They are never found except in places where animals (or human beings) discharging tubercle bacilli live or have lately lived. Tuberculosis is a purely contagious disease.

This view is strikingly confirmed by a closer examination of herds among which tuberculosis is found. Only such herds are perfectly healthy as are kept up by breeding, receiving hardly any increase from outside, except a calf now and then, while the prevalence of tuberculosis is generally the greater the more frequently the stock is increased by buying cattle at fairs, and consequently the most infected parts of the country are those where a brisk trade in cattle is being done and where buying and selling of cattle is common.

Another way by which infection may be introduced among hitherto healthy stocks is by feeding calves on skimmed milk from a coöperative dairy, among whose suppliers will always be found owners of tuberculous cattle. In cases where the infection had been introduced through the milk, the cows were very often healthy, while it was the calves or the young cattle that reacted; sometimes the peculiar fact might be observed that only animals of the same age—for instance, yearlings or two-year-olds—reacted; and when this happened, the heating apparatus of the dairy was found to have been out of order just at the time when milk was supplied to the set of animals that had reacted.

In all other cases the tuberculin test proved conclusively that tuberculosis is more prevalent among old than among young cattle. A close examination of 40,624 head of cattle, which during the years of 1898–1904 were subjected to the tuberculin test for the first time, showed that of calves under six months, 12.1 per cent. reacted; of yearlings (from six to eighteen months), 27.5 per cent.; of two-year-olds (from one and one-half to two and one-half), 38.6 per cent.; of full-grown animals (from two and one-half to five), 44.9 per cent.; and of animals over five years old, 48 per cent.—figures which correspond with the results of tuberculin tests in other countries, as well as with the experiences of slaughter-houses and with the results of the study of human tuberculosis.

The method, recommended by Bang, for enabling cattle-farmers to combat tuberculosis by their own efforts, *i. e.*, strict isolation of the healthy animals and feeding calves on uninfected milk (milk of perfectly healthy animals or milk heated to 85° C.—now only 80° C.), had at first many enthusiastic followers, as will be seen by the following table:

	Stocks.		Number of Animals Tested.		Percentage of Reacting Animals.
	Total Number.	Number of Stocks Tested the First Time.	Total Number.	Of These Reacted.	
April, 1893–June, 1894....	327	327	8,401	3,362	40.0
June, 1894–October, 1895 .	1,873	1,645	44,902	17,303	38.5
October, 1895–May, 1896 .	930	749	20,791	6,622	31.9
May, 1896–June, 1897...	7,316	3,012	84,897	21,668	25.5
June, 1897–May, 1898...		2,165	65,788	15,642	23.8
May, 1898–Jan., 1899.....	1,454	618	35,533	7,725	21.7
1899.....	1,293	543	33,568	6,759	20.1
1900.....	1,101	417	26,078	4,976	18.0
1901.....	695	259	18,818	2,857	15.2
1902.....	895	396	23,347	3,531	15.1
1903.....	646	213	19,364	2,875	14.8
1904.....	738	277	23,164	3,750	16.2
1905.....	705	221	24,161	3,370	13.9
1906.....	689	294	25,035	3,398	13.6
1907.....	580	232	22,982	2,252	9.8

After a few years, however, there was a sad falling-off. The carrying out of the above measures demands great vigilance and perseverance on the part of farmers as well as on that of their servants, qualities not often met with. The importance of strict isolation was not at first fully realized by all, the watchfulness was often relaxed, the disinfection of the stables was not always as thorough as it should have been, the milk was not always sufficiently heated. Many farmers thought the method too troublesome in the long run. If accidents happened, so that too many animals of the healthy division reacted on the repetition of the test, the farmer would lose courage and listen to the many voices (especially those of butchers and cattle-dealers) eager to assure him that the tuberculin test was mere humbug. The serious misuse of tuberculin in employing it for the immunization of cattle intended for export to Germany for killing purposes—these animals, according to the peculiar German regulations, are to be subjected to the tuberculin test in passing quarantine at the German frontier—contributed greatly to the dissemination of wrong ideas among the public. The well-known and unfortunate circumstance that highly tuberculous and consequently infectious animals sometimes do not react at all, or only very slightly, must also be taken into account, veterinary surgeons sometimes neglecting to subject the non-reacting animals to a sufficiently careful clinical examination, so that it sometimes happened that a specially infectious animal was placed among the healthy ones.

However, although there was a great falling-off, many farmers have persevered, and most of them—both owners of large and of small stocks—have

obtained excellent results. For instance, on the first application of the test in 1894 at the farm of Borupgaard in Jutland, 139 out of the total number (82 per cent. of the full-grown animals) reacted, and only 86 were found to be healthy. When the test was applied at the same farm in 1908, out of 245 animals only one calf reacted, and so slightly that the reaction must be considered doubtful. This excellent result had been attained by strict isolation (division of the large stable by a wooden partition and separate stables for calves and young cattle). According to the careful calculations of the owner of the farm, the total expense of the isolation was about 1000 kr.

When the test was first applied in 1896 at Count Wedell's estate, Wedellsborg (Funen), 166 of the animals reacted and only 74 were found to be healthy. Now there is a stock of 264 head of cattle, of which only 3 reacted in 1908. In this case the division of the stable had been effected by means of a brick wall. Although during the first few years a very small percentage of the animals did not pass the half-yearly tests, the result was now and then rather bad, as when, on one occasion, as many as 22 per cent. reacted, which discouraged the owner of the estate so much that he very nearly gave up the whole thing. Fortunately, however, he persevered, and eventually reaped the reward of his exertions.

A well-known cattle-breeder—Mr. Ahlmann, of Langholt and Striben (Jutland)—had, in 1895, 271 reacting and 68 healthy animals. At present the reacting division has been reduced to 10, while of the remaining stock on his two farms, only 6 out of 373 animals reacted at the last test. Mr. E. Tutein, of Edelgave (Sealand), had in 1895 115 reacting animals and 48 healthy ones; the last time the test was applied, only 2 out of 158 reacted. As early as 1899 Bang, in the report submitted by him to the veterinary congress of Baden-Baden,* expressed his opinion that the best way to root out tuberculosis in a large stock among which the disease had long been prevalent would be to subject at first only calves and young cattle, and none of the full-grown animals, to the test, as experience had shown that among such a stock 80 per cent. or more of the full-grown animals would react. Consequently only very little would be gained by isolating the 10 or 20 per cent. of non-reacting cows, as a great number of these animals, having for a long time been exposed to infection, would turn out to be infected, even if they did not react. Not a few of such cows will be found to have in some of the lymphatic glands small tubercles of long standing, encysted, it is true, and consequently harmless, but still in some cases liable to break out again. By not subjecting the full-grown animals of their stock to the test, farmers would avoid the unpleasantness of learning (and of having to tell their friends!) that the greater part of their stock was infected, and the task of isolation would be the easier at first.

* Congress Report, vol. i, p. 541.

It is really beyond comprehension that every great cattle-farmer who is the owner of a valuable herd, and knows it to be infected, does not take the simple precaution of isolating his calves from the full-grown animals of his stock and feeding them on uninfected milk, *i. e.*, milk that is sufficiently heated or milk from a few perfectly healthy (non-reacting and clinically examined) cows. In countries where the "artificial" feeding which is common in Denmark is unknown, a way out of the difficulty would be to make some perfectly healthy cows act as wet-nurses and suckle the calves. Indeed, as has been proved by the Hungarian Ujhelyi, good results may be achieved even if the mothers are allowed to nourish their own calves, provided the calves are kept in separate stables, except when they are let in to their mother for feeding two or three times a day. This breaking away from the isolation rule involves, of course, some danger of infection; there is, however, a great difference between such a brief exposure to infection and constant cohabitation in the same stable day and night.

Of course, the isolated calves should be subjected to half-yearly tuberculin tests, so that the infected ones may be removed as soon as possible, and the healthy stock which is being formed by the above measures should, of course, be kept continually apart from the old infected stock. The Ostertag method of keeping the healthy animals isolated only as long as they are young, and later stabling them together with the full-grown cattle, cannot by any means be recommended, as the infected stock, even though its sanitary condition may be improved by removing the most infectious animals by means of a careful clinical control, will never be so completely rid of animals that may transmit infection as to obviate further danger. This cannot be attained by the clinical control alone.

For great landed proprietors, owners of several farms, it will be an easy matter to get rid of tuberculosis by sending all the healthy animals of their stock to one of their farms, and gradually—by means of the above method—eliminating the infection from the herds of their other farms. The following account of how matters were managed at the farm of Ourupgaard and three other farms at Falster, belonging to Mr. Fr. Tesdorpf, may serve as an instance to show how infection may be rooted out in this easy and cheap way. Here a beginning was made in 1893 by subjecting calves and young cattle of the stock of Ourupgaard, but no full-grown animals, to the tuberculin test, with the result that 31 reacted, while 152 were found to be healthy. The healthy animals were strictly isolated first at Ourupgaard, in separate stables; later at two of the other farms. During the succeeding years the testing of this healthy stock of young animals, as also of the calves that were born, was continued. At first the result here, as at many other farms, was sometimes rather unsatisfactory; for instance, in 1896, when 23 animals out of 361 reacted; but in time, as the isolation was carried out more and more

carefully, better results were obtained, until last year, when at the four farms belonging to Mr. Tesdorpf, only 11 animals out of 876 reacted. At one of the farms there is still a herd of 114 reacting (or non-tested) animals.

Just as good results have been obtained by Count Danneskjold-Samsoe at his three large farms in the island of Samso. Here, as early as in 1891, a beginning was made by testing the calves, of which relatively few reacted. The reacting animals were killed, and the healthy calves and young cattle were kept isolated for some time, only, however, until the beginning of the calving season—which was certainly a great mistake (one that could not be prevented, the test being a private one). They were then placed in the large, well-appointed stable, together with the non-tested cows, which, though apparently healthy, infected the others, so that when at length Bang, in 1898, prevailed upon Count Danneskjold-Samsoe to have the whole stock, which during six or seven years had been continually recruited with absolutely healthy young animals, subjected to the test, 286 animals reacted, while only 29 were found to be healthy! From that time the healthy animals were kept isolated at two of the other farms. In 1901 there were at one of these farms 208 animals, which all passed the test, and at another 126, 4 of which reacted. In December, 1907, there were in the healthy divisions 593 animals, of which 2 reacted, though doubtfully, on being subjected to the test. In addition, there was still at one of the farms a reacting division of about 30 cows. So the great task of changing a large tuberculous stock into an all but healthy one by breeding had been accomplished in ten years—an excellent result, indeed!

Excellent results may also be obtained by isolation at one farm, as will be seen by the two following instances: In 1896 Farmer Langermann of Faurholm had 45 calves subjected to the test, 15 of which reacted. From that time until now the calves bred at the farm have been tested and kept isolated, while the full-grown animals of the stock were not tested at first. That they were highly tuberculous was proved by the fact that 19 of the apparently healthiest cows reacted on their being subjected, in 1900, to the test as an experiment. Gradually a perfectly healthy stock has been bred, numbering—in April, 1908—197 animals, none of which reacted when tested.

At the large estate of Voergaard in Jutland (belonging to Mr. Scavenius) the same method of leaving the full-grown animals untested at first was adopted. In 1895, 94 yearlings and two-year-olds were tested, half of which reacted. The result of continued isolation of the calves and the young cattle and repeated tuberculin tests (of the calves twice yearly, of the older animals only once) is that there were in 1907 healthy divisions numbering 443 animals, of which only 9 reacted upon the application of the test, and a reacting division of 41 animals. The manager of the cattle-farm was much struck by the gratifying fact that the cows live much longer now than at the time

when tuberculosis was prevalent among them—a fact that is, of course, of the greatest importance as regards the profits of cattle-farming, and which is generally taken too little into account.

It is by no means only at the large farms that excellent results have been obtained by the method of isolation. It is, indeed, quite possible to carry it out at the small farms as well. The difficulty at these farms is, of course, to find two sets of stable hands to tend and milk the two divisions, but, on the other hand, there is the advantage that at a small farm nothing escapes notice, and that the farmer can personally see to the execution of his orders. A small farmer, if he has only intelligence enough to grasp the main point, can, much more easily than a great land-owner, take care that the transmission of infection is avoided. Generally it will not be necessary to have two sets of stable hands, if only the rule of tending and milking the healthy division first is strictly adhered to, and if the hands change their boots or shoes, and, preferably, their overalls as well, on going from one division to another, and use different sets of implements in the two divisions.

It is a fact that the carrying out of the method of isolation has been attended with excellent results on many small farms. Where only few animals reacted, it was easy enough to get rid of the disease; but also in cases where almost the whole stock was infected, the gradual elimination was often successfully accomplished. It may here be mentioned that it repays one's trouble to work for small farmers—men who have felt their economic existence threatened by the prevalence of tuberculosis among their cattle. These men are deeply impressed with the importance of getting rid of the disease and so take more care, in performing their daily duties, to avoid the transmission of infection than do most others.

The result of a computation made by Bang in 1905 was that at 66 small farms, of which the average number of stock was 29 head of cattle, a gradual changing of what were for the most part highly tuberculous herds into healthy ones had been successfully accomplished by the method of isolation. When this work was begun, the total number of reacting animals on these 66 farms was 1045, and of healthy ones, 780; when it was finished, there were 1896 healthy animals, and none reacting. On being asked, several of these farmers told Mr. Bang that the work had certainly caused a good deal of trouble, but that the expense was nothing to speak of. Thus one farmer had, by spending a sum of less than 200 kr. on the establishment of two small provisional byres in one of his farmhouses, succeeded in changing his highly tuberculous stock (12 cows and heifers of which he had had to sell for a mere song within a few years) into a perfectly healthy one, numbering 30 head of cattle,—in 1907 there were 36,—which have been several times subjected to the tuberculin test and have each time been found to be healthy. Other farmers have achieved similar excellent results at still smaller cost.

It will thus be seen that there is not the slightest doubt that both small and large cattle-farmers may gradually change a tuberculous stock into a healthy one, if they are determined to do it, and if they have quite grasped the nature and the modes of infection of tuberculosis.

N. O. Nielsen, veterinary surgeon (Remkolde near Vordingborg, Sealand), has had the good idea to persuade a great number of the small cattle-farmers of his district to join an association, with the object of "promoting the breeding and maintenance of healthy, non-tuberculous stocks of cattle and pigs." Only such farmers are allowed to join as have had their stock subjected to the tuberculin test, and, in case of its proving only partially healthy, have suitably isolated the healthy animals from the diseased ones. No increase of the stock by animals of other stock, except calves under one month, is allowed, unless they come from a healthy stock and have been found healthy on being infected with tuberculin. The object of the association is, besides setting a good example, to facilitate the purchase of healthy animals, as members who want to buy or sell may apply for advice to one among them who keeps a list of the farms where healthy animals are for sale. To some of the members is delegated the task of superintending the heating of milk at the dairies. Members pay a subscription of 2 kr. yearly.

The association was started in December, 1905, and has prospered so much that it has now 125 members possessing stock amounting to 2740 cows and young cattle. (According to a report, dated January 1, 1908, 2070 of the 2442 animals of the association were healthy, and only 14 of the members had reacting (isolated) animals—372 in all.) Within three years the task of rooting out tuberculosis from 25 stocks of cattle has been accomplished by means of killing or selling the reacting animals. (On the first application of the test 85 stocks—most of them very small, it is true—were found to be healthy.) More than half of the cattle of the 4 parishes—the scene of the labors of the association—belong to members. There is no doubt that such associations may do much toward rousing an interest in small farmers in the great problem: How to breed healthy cattle and pigs. "Union is strength" may be more truly said of Denmark, where so much is achieved by coöperative farming, than of any other country.

The growing interest in the rational application of the tuberculin test and the method of isolation has, in addition to the founding of the above association, manifested itself lately in another way.

During the last seven or eight years several thousand head of Jersey cattle have been imported into Denmark direct from the island of Jersey. These cattle, as well as all other cattle that are imported for breeding purposes, must undergo a brief quarantine detention and are subjected to the tuberculin test (in accordance with the act of February 5, 1904, relating to the combating of tuberculosis among cattle and pigs). This has further corrob-

orated the truth of the already well-known fact that tuberculosis is all but unknown among the Jersey cattle—an interesting circumstance which is accounted for by the fact that the Jersey stock has been kept pure for more than one hundred years, the importing of cattle, except for immediate slaughter, being prohibited, probably to prevent the introduction of rinderpest. Of the Jersey cattle imported into Denmark, only very few animals reacted on being subjected to the test, and when these animals were killed, it was either quite impossible to demonstrate the presence of tuberculosis (accidental fever), or it was found to be present in a very slight degree only (perhaps caused through human infection?). On being placed among infected Danish cattle, healthy Jersey cows will very soon become tuberculous; sometimes even they have been known to give way to the disease quicker than Danish cattle. The man who first imported Jersey cattle, and who is the most eager advocate of the introduction of this excellent breed, which, owing to its wonderfully rich milk, is of special value to a butter-producing country, viz., Mr. J. Larsen (Gaardbogaard), was fortunately also a very eager advocate of the use of tuberculin, and has always taken good care to keep his stock free from tuberculosis. Consequently it has been easy for him to induce the majority of the cattle-farmers who import Jersey cattle to keep their newly imported animals free from the disease by means of isolation. There are at present about 5000 head of Jersey cattle in Denmark,—on small as well as on large farms,—most of which are either quite free from tuberculosis or successful efforts are being made to make them so. At many of these farms the stock is composed exclusively of Jersey cattle: at some the breed is mixed.

The foregoing is chiefly an account of what is being done in Denmark to combat tuberculosis among cattle by the cattle-farmers, assisted by the State, which pays the expenses attendant on the tuberculin tests on condition that the farmers bind themselves to keep their healthy animals safely isolated from the infected ones. In conclusion follows an account of the two measures with the same object (as passed by the Legislature):

The amendment in 1898 of the Tuberculosis Act of 1893 provides that all cows found suffering from tuberculosis of the udder are to be killed, and that a partial compensation is to be paid to the owner by the State; further, that all skimmed milk and buttermilk returned from dairies to be used as food for calves and pigs is previously to be heated to 85° C. In 1904 an amendment was added providing that the compensation for a cow killed on account of tuberculosis of the udder is to be increased a little, so as to represent one-third of the market value of the carcass, calculated at the current average price for meat of inferior quality if the meat is declared by a veterinary surgeon to be fit for human consumption (which happens very rarely), and five-sixths of the market value of the carcass if the meat is condemned. By an

amendment of the provision relating to the heating of the milk it was provided that the milk is now to be heated to 80° C. instead of to 85° C., and that this provision is also to apply to cream destined for the making of butter for exportation. The object of this latter provision, which has, of course, in itself nothing to do with the endeavors to combat the prevalence of tuberculosis among domestic animals in Denmark, is to keep Danish butter free from viable tubercle bacilli. It cannot be said to have revolutionized the dairy work to any great extent, as the heating of buttermilk has always been performed indirectly by heating the cream. Long before 1898 it was common enough to heat the cream very considerably in order to insure the perfect purity of the butter. There is no doubt that the usual heating of the cream and the adding of cultures of acidifying bacteria before the churning have contributed much to the practically invariably superior quality of Danish butter.

The object of the killing of cows suffering from tuberculosis of the udder is to get rid as soon as possible of these animals, through which, more than through any others, infection may be spread to calves, pigs, and other domestic animals, and also, undoubtedly, to human beings, especially children, if the milk is taken raw. The endeavors to combat tuberculosis of the udder have met with great sympathy among Danish farmers. About 2500 samples of milk of cows, suspected of suffering from this form of tuberculosis, are sent in yearly through veterinary surgeons to the laboratory of Dr. Bang, and the microscopical examination of these samples, either of the particles produced by exudation, or—in case of the milk being unchanged—of the sediment after centrifugation, showed tubercle bacilli to be present in about 30 per cent. of the cases. After the killing of the cow parts of the diseased udder are subjected to examination in order to ascertain the correctness of the diagnosis, which in only about 1 per cent. of the cases has turned out to be at fault. About 700 cows are killed every year, and the compensation paid for them generally amounts to 50,000 kr. yearly.

The object of the killing of cows suffering from tuberculosis of the udder is, of course, best attained if the case is established when still at an early stage. The fact is therefore worth mentioning that of the 6228 cows suffering from tuberculosis of the udder destroyed in Denmark in the course of ten years, 2149, or 34.5 per cent., were still at a very early stage of the disease, as the secretion of the diseased gland still had the appearance of natural or almost natural milk. In many other cases also the rooting out of these infectious animals has had great hygienic importance, as cows suffering from tuberculosis of the udder may often go on living for months after their milk has changed, and even though at this stage the milk is not generally mixed with uninfected milk, it still contributes to spread infection in the stable by being milked on the floor.

The compulsory slaughter of these animals is therefore indubitably justified, but much more ought to be done. The best thing would be to order all cows suffering from "open tuberculosis," *i. e.*, all which discharge tubercle bacilli through any of the excretory ducts, to be destroyed, and partial compensation granted to the owner. Should the authorities hesitate for the present from acting upon this recommendation,—partly because of the expense, partly because it may be rather difficult in some cases to decide whether a coughing cow is suffering from pulmonary tuberculosis, especially of an ulcerative, infectious form,—there is at any rate one form of tuberculosis which is extremely easy to diagnose, as the presence of the bacilli may be proved directly, viz., tuberculosis of the uterus. This disease, which seems to be even more frequent than tuberculosis of the udder, is most infectious; not only are enormous masses of tubercle bacilli every day spread in the stable through the discharge from the vagina, but a great number are no doubt mixed with the milk during the milking. It is six years since the veterinary authorities of Denmark recommended that the same action should be taken with regard to cows suffering from this disease as with cows suffering from tuberculosis of the udder, but up to the present day their advice has been disregarded.

The most important of all the measures against tuberculosis among cattle and pigs which have been carried out in Denmark is the law relating to the heating of skimmed milk and buttermilk to 80° C. before it is returned from the dairies. As in Denmark nearly all milk not sold directly for consumption is sent to coöperative dairies, it is clear that there is very great danger of a wide dissemination of tuberculosis if raw skimmed milk and buttermilk are returned to the suppliers to be used as food for calves and pigs. There will always among the suppliers of a dairy be one or more farmers who have a highly tuberculous stock, one or more cows of which yield in the course of the year great quantities of infected milk, and so, by employing this milk, after it has been skimmed, to feed other stocks, the infection is spread to hitherto healthy herds. As mentioned above, this was formerly done on a large scale, and there is no doubt that most stocks of cattle and pigs in Denmark would gradually be infected in this way if measures had not been taken to prevent it. Of course, the heating of the whey ought to have been enforced by law as well; this was proposed, but the proposal was not accepted, chiefly because the heating of the whey is rather troublesome. It is, however, to be hoped that this measure will be carried out some day, though, as whey is mostly used for feeding pigs, it is not so important as the other dairy products, as regards bovine tuberculosis, and, besides, cheese-making is not nearly so considerable in Denmark as butter-making.

In Denmark the observance of the law regulating the heating of skimmed milk is controlled by the police as well as by the margarine and butter in-

spectors, who procure samples at the dairies and send them to the laboratory of Prof. Storch, where they are subjected to his color test, which consists of pouring a few drops of paraphenylen-diamin and peroxid of hydrogen into the milk. The milk turns blue if it has not been heated to 80° C. Offenders against the act are fined. On the whole, the regulations governing the heating of milk are fairly scrupulously carried out, though, of course, there are exceptions. The best plan would be for one or two of the suppliers of each dairy to apply the above easy and simple test every day. This is done in some places and has produced very good results.

One useful provision of the Tuberculosis Act is that the sediment deposited on the sides of the cream-separator is to be burned, which is no doubt always done now. In old days this product was now and then used as food for pigs, and thus many pigs were infected, as it contains enormous masses of tubercle bacilli which are separated from the milk by the centrifugal force.

ACT OF FEBRUARY 5, 1904, CONTAINING MEASURES AGAINST TUBERCULOSIS AMONG CATTLE AND PIGS.

A sum of 100,000 kr. granted every year by the Rigsdag (Parliament) on the recommendation of the Committee of Ways and Means shall be placed at the disposal of the Minister of Agriculture for the support of cattle-farmers who wish to employ tuberculin as a diagnostic remedy in combating tuberculosis among their cattle, the tuberculin test being applied according to detailed regulations issued by the Minister. The support shall be granted to none but such farmers as guarantee their ability to keep the animals, proved by the test to be healthy, safely isolated from the animals affected by tuberculosis, or which have not been subjected to the tuberculin test.

The Minister of Agriculture shall—on the same conditions—be entitled to employ part of the sum to support cattle-breeding associations which wish to subject the animals selected for breeding purposes to the tuberculin test, as well as to support farmers' associations desiring to subject cows belonging to cottagers to the tuberculin test.

Farmers who do not fulfil their obligations with regard to isolation shall return to the State the grants which have been made to them in accordance with the above provisions.

Any veterinary surgeon superintending the application of the tuberculin test on a farm shall satisfy himself, under penalty of a fine, that safe isolation between the animals is established, and if his orders to this effect are not obeyed by the farmer, he shall notify this to the chief veterinary surgeon of the country.

Applications from cattle-farmers, cattle-breeding associations, and farmers' associations desiring to take advantage of the opportunity offered to them by this Act of having their cattle subjected to the tuberculin test shall be sent direct to the Minister of Agriculture.

Sec. 2.

Importation of live cattle from abroad shall only take place at such

places as are mentioned in the regulations issued by the Minister of Agriculture. Immediately after their arrival the animals shall be quarantined, and shall, in accordance with the regulations of the veterinary police, be subjected to the tuberculin test, according to regulations issued by the Minister of Agriculture, within five days after their arrival at the quarantine stable. After the test the non-reacting animals shall be left at the disposal of the owner, while the reacting animals shall either be returned or taken direct to a public slaughter-house or to a slaughter-house recognized by the Minister of Agriculture, where same shall be destroyed under control of the veterinary police.

The expenses incurred in providing the requisite quarantine stables at the places of import, as well as the expenses of the tuberculin tests, but none of the expenses attendant on the other measures mentioned in this section, shall be borne by the State.

The regulations relating to tuberculin tests, mentioned in sec. 1, shall also apply to such other diagnostic remedies as may be recommended by veterinary authorities for the combating of tuberculosis among cattle, and are approved by the Minister of Agriculture.

Sec. 3.

Animals imported for killing purposes may be exempted from quarantining and the tuberculin tests ordered in sec. 2.

Such animals shall, after having been branded (see sec. 4), be taken direct to a public slaughter-house or to a slaughter-house recognized by the Minister of Agriculture.

The Minister of Agriculture shall be entitled to permit cattle imported for killing purposes—after having been marked—being taken direct to a cattle-market, where the animals shall be stabled so as to be, in the opinion of the veterinary police, duly isolated from all other cattle. From this place they shall be taken direct to a public slaughter-house or to a slaughter-house recognized by the Minister of Agriculture.

The animals imported for killing purposes mentioned in this section shall be killed within ten days after their arrival in this country.

Sec. 4.

The Minister of Agriculture shall issue regulations for the marking of the imported animals.

Sec. 5.

Cows suffering from tuberculosis of the udder shall be killed, in accordance with the regulations of the State, under control of the veterinary police or in a public slaughter-house. The owner shall be entitled to a compensation for the animal, amounting to one-third of the market value of the carcass, calculated at the current price, according to regulations issued by the Minister of Agriculture. The owner shall further be entitled to a compensation for such parts of the animal as are declared by the veterinary surgeon to be unfit for human consumption, amounting to half of the value of the condemned meat, calculated as above. Such parts of the animal as are declared fit for human consumption shall be left at the disposal of the owner.

The compensation as well as the expenses attendant on the killing shall be paid by the State.

Sec. 6.

None but such milk and buttermilk as has been heated to a temperature of at least 64° Reaumur (80° C.) shall be returned from dairies to serve as food for cattle and pigs. Exceptions from this rule may take place when the heating cannot be performed on account of an accident, which fact shall be made known to the person to whom the milk is to be returned.

The heating mentioned in this section shall also apply to all cream destined for the making of butter for exportation.

The sediment scraped off the sides of the cream-separator during the cleaning of the same shall be burned.

Sec. 7.

None but such milk and buttermilk as has been sufficiently proved in the opinion of the Minister of Agriculture to have been heated to a temperature of at least 64° Reaumur (80° C.) shall be imported from abroad. The Minister of Agriculture shall, however, be entitled to grant exemption from the above prohibition when special circumstances necessitate it.

Sec. 8.

The carrying out of the provisions of this Act shall be enforced by the veterinary police, the custom-house officers, and the butter and margarine inspectors in accordance with the directions of the Minister of Agriculture.

Sec. 9.

Offenders against the provisions of sections 1, 2, 3, 6, and 7 shall be liable to fines of from 10 to 20 kr. for the first offense; in case of repetition, to fines of from 20 to 200 kr. Repeated offenses against sec. 6 shall not be looked upon as such if at least one year has elapsed since the offender was last fined. The fines shall accrue to the exchequer. The proceedings in these cases shall be summary. In the case mentioned in sec. 7 the prohibited articles shall be confiscated and heated to the temperature defined in the above section. In Copenhagen the proceeds of the sale of such articles shall accrue to the municipal fund; in other places, to the poor fund.

Sec. 10.

This Act, which shall not apply to the Faroë Islands, shall come into force October 1, 1904.

DISCUSSION.

Mr. Pope: I think the latter part of this paper contains a very important suggestion for the American farmer. It would be much easier for the average American farmer to leave his old herd and start a new one. This seems to be more workable than testing the cattle and then weeding out the reactors. The danger is, of course, in leaving the old infected animals in the herd. This phase of the question, which Professor Bang has brought out, should be very impressive for the Americans, although the climatic conditions are very different in the United States.

Dr. Deering: I would like to ask Professor Bang if his government compensates the farmers for cattle that are slaughtered.

Prof. Bang: Only for those affected with udder tuberculosis. We pay about $20 per head for animals that are destroyed. We pay according to the work and meat value and the market price, which brings the amount to about $20 a head.

Dr. Pearson: In the way of explanation for Professor Bang, I would like to state that Maine has a very low percentage of tuberculosis, and that the disease has been almost eradicated from that State.

Dr. Rutherford: It appears that the gentleman from New York and Professor Bang are looking at the matter from two points of view. It is a problem which has not yet been fully solved. Professor Bang has perhaps come as near as any one else to solving it. There seems to be a confusion of ideas as to the province of a veterinarian in relation to health officers. The health officers are medical men. They are anxious to prevent tuberculosis, and it is their duty to see that no milk affected with tubercle bacilli is furnished for consumption. If legislation is obtained by a State enabling a municipality to forbid absolutely the supplying of milk for human consumption from tuberculous cows, then it is the duty of the health officer to enforce this law through the veterinarian. If it is necessary to separate the calves from their dams and to heat the milk to 80° C., does Professor Bang not think there is some responsibility in allowing children and human beings to drink that milk without that precaution? Another point: if butter is made in Denmark from heated cream, is it all right? These things are not done in this country. The proposition is made that all by-products should be sterilized before being allowed to go out from the farm. I do not think that Professor Bang should permit people to consume milk which he will not permit to be fed to calves. I would like to ask him whether or not he has seen any serious results from tubercular infection of the supramammary gland as well as the udder itself.

Prof. Bang: I cannot say with certainty that I have seen any infection from tuberculosis of the supramammary gland. There may be present tuberculosis of this gland without it appearing in the udder. I am sure about using milk for children—only by accident. Investigators claim that bacilli will not exist in the milk if the cows have no clinical symptoms. I made many experiments with milk of highly tuberculous cows with hardened udders, and I found in only 14 per cent. of such cases that the milk contained tubercle bacilli, by the injection of guinea-pigs. Therefore I think there is no danger from the milk if the cow shows no clinical symptoms of the disease. In our country milk is prohibited from being sold for consumption by children unless it comes from an absolutely clean herd.

THE CONTROL OF BOVINE TUBERCULOSIS.

By Dr. J. G. Rutherford,
Ottawa, Canada.

It would be most unbecoming in me, following the various distinguished speakers who have taken part in the discussions of this Congress, and especially at this late date in the proceedings, to occupy any great length of time in laying before its members the few ideas on the control of bovine tuberculosis which I have been able to put together in the limited period at my disposal. I observe that on the official program the subject assigned to me is the "Control of Bovine Tuberculosis in Canada," the last two words having been added to the title originally sent in by me. I have but little to say on the control of bovine tuberculosis in Canada, inasmuch as while in some districts, under municipal and provincial laws, efforts are being made to control the disease in dairy herds supplying various centers of population, very little is now being done by the Federal government through the Health of Animals Branch of the Department of Agriculture, which is in my charge.

Although for some years, at a period prior to my assuming office, a very considerable amount of testing with tuberculin upon the application of owners was carried on, no appreciable benefit was found to result, and, as a matter of fact, we now confine ourselves to the testing of cattle imported or exported for breeding purposes, those on the experimental farms, and a few other herds which have been placed by their owners under the direct control of our officers. We, however, on the request of owners of cattle who desire them tested, supply tuberculin free of charge to any reputable, qualified veterinary surgeon, on condition that he will send to the Department the results of the tests made by him, on charts which we furnish for that purpose.

All cattle reacting to tuberculin in Canada, save those privately tested, are permanently earmarked by cutting a large T out of the right ear.

I may as well frankly state that the reason for this apparent inertia is that, so far, no satisfactory, intelligent method of dealing with bovine tuberculosis has been evolved, and we deem it wiser, before taking action, to await the results of the investigations, now being conducted by veterinary scientists in various countries, in the hope that some better way of dealing with the problem may be discovered.

Our knowledge of tuberculosis, the tuberculin test, and of their vagaries, has all along been defective and incomplete, and undoubtedly is so to-day, and when we bear in mind the many legislative mistakes which, owing to this lack of exact knowledge, have been made in the past, it must be admitted that caution is commendable, and that, before taking any definite departmental action involving the large interests which are at stake in such a country as Canada, it is reasonable that we should "look before we leap," and guard, as far as may be, against the possibility of having to recede, more or less ignominiously, from a position once taken.

Many of our medical friends, and some veterinarians whose zeal outruns their discretion, advocate compulsory testing and the slaughter of all reacting animals. At first sight, to men lacking practical experience, and perhaps devoid of responsibility, this policy may appear a very simple solution of the problem. That it is very far from being so, however, needs but little demonstration to an audience of this nature. All practical veterinary sanitarians, dealing in large matters, are, even without taking into consideration the painful experience of those communities which, in earlier days, were rash enough to adopt it, well aware, not only of the great difficulties to be encountered in carrying out such a policy, but of the fact that under ordinary circumstances, in spite of the great economic waste involved, its results are by no means so satisfactory as its advocates would like to have us believe. Most of us can remember the time when the majority of veterinarians, many of whom should have known better, believed that if a herd of cattle were tested, the reactors destroyed, and the premises disinfected, the disease was stamped out, and the owner might thereafter be left to follow his own courses. Intelligent men have, of course, understood from the beginning that there must be, in the very nature of things, a period of latency or incubation between the time of infection and that when an infected animal would react to tuberculin. This period was fixed in 1899 and 1900 by contemporaneous but entirely independent experiments, carried on by the Tuberculin Committee of the Royal Agricultural Society of England, and by Drs. Nocard and Rossignol, under the auspices of the Société de Médecin Vétérinaire Pratique of France. The results in both cases were practically the same, and showed the period of incubation, while depending somewhat upon the mode and degree of infection, to range from eight to fifty days. This fact, affecting vitally, as it does, both the original herd and any additions or replacements which may be made, is in itself a very serious obstacle to the satisfactory working out of a policy of compulsory testing and slaughter, even with liberal compensation. Taken in conjunction with the vagaries of tuberculin, especially on second, third, and fourth tests in the same herds, and the numerous ingenious methods adopted by owners, especially of pure-bred cattle, in order to defeat the test, it is

sufficient to exclude from the field of practical action this method of dealing with tuberculosis, except in small and circumscribed communities, in which all, or at least a majority of, the owners are alive to the necessity of stamping out tuberculosis and are willing to coöperate heartily with the authorities in bringing about that result.

This conclusion on my part has not been rashly arrived at. Ever since tuberculin was first used as a diagnostic agent in bovine tuberculosis I have been studying its action, and during the whole of that period my opportunities for such study have been considerably greater than fall to the lot of the average veterinarian.

Let us go a little more into detail. A herd of, say, one hundred cattle kept under ordinary stable conditions is tested, and twenty-five reactors are found. These twenty-five animals, together with any which, owing to the disease being in an advanced stage, may fail to react, but which are detected by clinical examination, are slaughtered and the premises carefully disinfected. It is not so very long, as I have already said, since many veterinarians were teaching that such a herd was safe and sound, and that, provided any animals added were carefully tested before being brought into contact, no further danger need be apprehended. This is, of course, very far from being the case. In the first place, a retest after three months will, depending to some extent on the virulence of the particular infection—a point of great importance—and the sanitary conditions, reveal perhaps from five to ten new reactors. Even after these have been destroyed and the premises again disinfected, the herd is by no means safe. The ten reactors, taking that as the number, have been living in close contact with the remaining sixty-five, and it is quite likely that three months later several of the latter will be found to be affected. Here also comes into play the uncertainty of tuberculin in repeated tests—a most serious consideration. In spite of Professor Vallée's important and valuable discovery,—which, I may say, does not by any means apply in all cases,—it is quite within the bounds of possibility that a number of animals, affected to a greater or less degree, will fail to react when tested for the third or fourth time. This acquired tolerance to tuberculin is one of its most serious limitations, and constitutes another difficulty somewhat hard to overcome. Let us admit, however, that after the lapse of a longer or shorter period, and a number of carefully conducted retests, the survivors of the original herd are properly pronounced healthy.

We must now take into consideration the question of additions and replacements—one which, from a business standpoint, is, in the majority of instances, of paramount importance to the owner. It is not enough to have the new animals tested before bringing them on to the premises. The same limitation, viz., that of the incubative period, applies to such tests as to

those with which we have been dealing. New arrivals must be isolated, not only from the original herd, but from each other, and submitted to a retest at the expiration of at least three months before being allowed to come in contact with any other cattle.

Two further points here demand our attention. We have hitherto, presumably, been speaking of tests honestly applied to the cattle of an honest owner, and by a capable, intelligent, and experienced veterinarian. We must now first consider some of the nefarious methods employed by dishonest and unprincipled owners to nullify the test, and so defeat the end in view.

The old method of dosing beforehand with tuberculin, although still followed in many herds, has largely lost its value through the discovery of Professor Vallée above referred to, and is now, as a rule, employed only when the testing veterinarian is agreeably complaisant, or a few years behind his age. It has, among the more astute breeders and dealers, been largely superseded by the practice of administering one or other of the modern antipyretics, combined for the sake of safety with other drugs, to such animals as are known to be tuberculous, or which show any rise of temperature when undergoing the test. This plan is beautiful in its simplicity. Temperatures are quietly taken from half an hour to an hour before the veterinarian makes his rounds, and the febrifuge, mixed with a little sugar and disguised in a handful or two of meal, is licked up by the animal without fuss or trouble. There is no drenching, no handling, no excitement; the temperature drops, and although there may be and often is thermal irregularity, there is no distinct rise, and, above all, no tuberculin arch.

This brings us to the second of my two further points, viz., the veterinarian making the test. While, with all its limitations, I have great confidence in the diagnostic properties of tuberculin, I must confess to a feeling of suspicion with reference to all charts that are in any degree, what I may term colorless, unless I know that the man who signs them is an honest, conscientious, wide-awake, and experienced veterinarian. Too many men take it for granted that everything is fair and aboveboard, and, depending entirely on their thermometer readings, allow themselves to be hoodwinked by dishonest and unscrupulous owners. I could go into many details, and perhaps furnish some amusement, by recounting a few of the artful dodges resorted to in order to keep the veterinarian away from his cattle between temperatures so as to permit of their being safely manipulated, but time will not permit. One thing, however, should be emphasized, viz., the fact that in the overwhelming majority of cases we have, in addition to the temperature rise, a distinct clinical reaction, some of the most salient features of which may be, and often are, only temporary, while others persist until at

least twenty-four hours after injection. Among the temporary signs which may be noticed, as a rule, from six to twelve hours after injection, are, in severe cases, rigors, often accompanied by staring coat, general excitation, and frequently diarrhea. In less well-marked cases we have coldness over the loins, quarters, thighs, and tail, subacute excitation, and general malaise. Even when these symptoms have passed off, the animal maintains a standing posture and is more or less stiffened; there is loss of appetite, rumination is suspended, and in milch-cows the flow of milk is diminished.

Close attention to and observation of the animals undergoing the test are, in my opinion, indispensable. Even with them it is possible for mistakes to be made; without them the tuberculin test is very apt to be badly discredited. The older veterinarians here will recollect that, prior to the discovery of tuberculin, much attention was paid, both by teachers and practitioners, to the clinical diagnosis of bovine tuberculosis. Of late years this phase of practice has been almost entirely lost sight of, the younger men practically depending on tuberculin as a diagnostic. This state of affairs is regrettable, and should be remedied by cultivating, with regard to cases of tuberculosis, that habit of painstaking observation which alone makes for success in the diagnosis of most of the other maladies to which dumb animals are subject.

I might perhaps explain that the foregoing remarks on the necessity of care and exactitude in making tests are intended to emphasize the idea that only skilful and specially trained men can with safety be employed in this work—no small difficulty in itself, when it comes to undertaking a universal and compulsory testing policy. There is still more to be said against compulsory testing and slaughter. Many reactors are but slightly affected, and while in the case of beef cattle in good condition the loss from their slaughter may be insignificant, it is a very different matter when valuable pure-bred herds, or even common-grade stock thin in flesh, are condemned. It is true that with the latter the question of compensation may be more easily settled than with the former, but the matter of economic waste is only one of degree, for while the pure-bred reactors might live out their natural lives and produce much valuable and, with proper precautions, healthy stock, the thin grades might be fattened and slaughtered under careful supervision for purposes of human food. For the reasons given above, I am convinced that, at least on any large scale, the policy of compulsory testing and slaughter is not a practicable one.

Turning to the policy of voluntary testing, or testing in response to applications from owners—now followed in certain of the United States and in several of the countries of Europe,—I would point out that not only do most of the arguments against compulsory testing apply to it with equal force, but several other factors come up for consideration. Among these

perhaps the most important is the fact that in testing only those herds in a country which are voluntarily submitted to the authorities, the progress made in the direction of eradicating tuberculosis must, of necessity, be not only very slow, but very uncertain. Even Professor Bang admits that, under the experience of repeated and often disappointing tests, the patience and courage of our Danish friends not infrequently fail, and they become weary of well-doing and relapse into carelessness. This phase of the matter is one which must be taken into account, and when with it is considered the fact that the last to ask for the test are, as a rule, the breeders of pure-bred stock, whose herds are the principal agents in disseminating disease, the ultimate ineffectiveness of voluntary testing is pretty clearly demonstrated. Owners must obtain fresh blood from time to time, and unless a man is heart and soul with the authorities in their efforts to clean up his herd, and takes every possible and minute precaution accordingly, it is, so long as tuberculosis exists in the country, only a matter of time until his stock relapses into a condition of disease.

In this connection I have read with much interest the plan proposed by Dr. Niven, medical health officer of Manchester, and supported by Professor Delepine and Mr. Brittlebank, the chief veterinary officer of that city, which includes the forming of disease-free islands by eradicating tuberculosis from certain farms and gradually extending the work over small districts, to be still further enlarged as the system finds favor with stock-owners. While there are some features of the scheme—such as the spending of public money in specially selected localities, to the exclusion of other tax-payers, and the supplying of sanitary buildings, through bringing pressure to bear on landlords or otherwise—which are scarcely applicable to conditions in America, it is, in my opinion, much more sensible and likely to be productive of ultimate benefit than the diffuse policy of promiscuously testing a herd here or there over an extensive territory, difficult, if not impossible, to keep under observation or control without an enormous staff of well-trained, experienced, and absolutely conscientious veterinary inspectors having no interest, beyond that of duty, in the herds with which they are called upon to deal or their owners. I might here say that the policy of employing local practitioners for this work has been repeatedly tried, and, in my experience at least, has not, in the majority of instances, proved either beneficial or successful.

I have nothing to say against the Bang system itself; in fact I am, and always have been, one of its most consistent advocates and admirers. I cannot, however, after thirty years' experience as a veterinarian on this continent, and with the knowledge acquired in that time of conditions on the ordinary North American farm, bring myself to believe that it is capable of successful general application on this continent.

There is no doubt that if all our stock-owners were thoroughly intelligent, well informed, anxious to rid their herds of tuberculosis, and gifted with an infinite capacity for taking pains, either the Bang system or that of Ostertag might be adopted, with every hope of a successful issue. As matters stand, we must, in order to deal with bovine tuberculosis effectively, have some definite policy of legal control, and the question, to my mind, is whether or not such control can properly be based on the tuberculin test.

At present I am inclined to favor a combination of the systems of Bang and Ostertag with that of the Manchester men, accompanied by a closer supervision of infected herds than is recommended by either of the two first-named authorities, so far as I understand their methods. All clinical or, if they can be detected, open cases of tuberculosis should be destroyed; all the adults in herds in which such cases are found to be treated as if diseased, marked and segregated accordingly; all milk from such herds to be pasteurized, whether used for human food or for that of animals; the progeny to be effectively separated from the adults, regularly submitted to the tuberculin test, and kept by themselves until the disease has been eliminated from the premises by the death or removal of the affected parent stock. Any animals added to the healthy herd would, of course, have to be tested on purchase, and retested after three months' careful isolation. I am free to admit that this plan is open to many of the objections which I myself have advanced against the other two already mentioned, but it appears to me to obviate the enormous economic waste and the tremendous popular opposition involved in the policy of compulsory slaughter, while it promises, if systematically applied and patiently and carefully carried out, infinitely better results than can be hoped for from that of promiscuously testing the herds of only such owners as are willing to submit them to the action of the authorities. The presence of one or more actual clinical cases of tuberculosis in any herd would constitute a perfectly defensible and reasonable ground for official action, and by making notification by owners or veterinarians compulsory, as in other scheduled diseases, reliable information on which such action could be taken would in most instances be forthcoming.

As has been well said by the editor of the "Lancet" in commenting on the recent able paper of Dr. Overland, of Norway, the famous address of Dr. Koch in 1901 has, after all, by stimulating others to investigation and research, been productive of good, perhaps to an extent sufficient to offset the hesitation and delay in actual practical effort which it undoubtedly caused.

As a result of that address, we veterinarians to-day know, or perhaps I should say have the proofs conclusive and satisfactory, of many things which we knew before, but were scarcely able to prove, regarding the transmissibility to man of bovine tuberculosis and vice versâ.

And this brings me to vaccination—a subject on which I have nothing to say, beyond that, up to the present, the published results of inoculation with bovo-vaccine are, from a practical viewpoint, singularly confusing, inconclusive, and discouraging. The immunity acquired under the most favorable conditions appears to be of short duration, and any advantage which may be gained is, to my thinking, more than offset by the danger of spreading the disease.

Where cultures of the human type are used, the risks appear to be, if possible, even more serious. Weber and Tirze, working under the direction of the German Imperial Health Office, report, according to Theobald Smith, that the udder of a cow vaccinated with a human culture shed human bacilli into the milk for a period of fifteen months.

Let us make haste slowly in work of this kind, and be sure of our ground before we issue any more of these definite pronouncements, which make nasty swallowing later on.

I have now briefly and inadequately placed before this Congress my views regarding the various methods recommended by scientists for the control of bovine tuberculosis. While these views may to some appear pessimistic, they are at least honest, and have been carefully considered with due regard to the responsibility which the veterinary sanitarian intrusted with large interests owes to humanity at large as well as to those interests. Dogmatize as we may, we are still groping, and in this, as in other matters of a like nature, those who have delved the deepest are the least sure of their ground.

In the mean time, while we are awaiting, as I fear we will for some time yet have to wait, the discovery of a certain and satisfactory scientific method of dealing with bovine tuberculosis, let us, as practical men, carry on an energetic campaign of education among cattle-owners and the general public. Bovine tuberculosis will be stamped out when individual owners realize that it pays much better to keep sound cattle than to lose money and feed in maintaining herds tainted with disease. In this campaign of education there should first be taken up a question in regard to which veterinarians have hitherto, in most cases, been culpably negligent. If there is one matter to-day in which veterinarians are behind the age, it is that of failing to insist, at all times, in season and out of season, on the importance of live-stock of thorough and effective stable ventilation. Having before us the object-lesson afforded by the medical profession, and the marvelous results which its members are achieving by open-air treatment, not only helping, but actually curing, advanced cases of tuberculosis, to say nothing of checking the disease, as is now daily done, in its early stages, it is nothing short of disgraceful that we are yearly permitting thousands of valuable animals to become infected, owing to the unsanitary conditions

under which their owners insist on keeping them. Of the truth of this contention, which is, perhaps, at first sight, rather sweeping, there is no lack of proof. In northern countries, where cattle are generally closely housed, and where a proper system of ventilation is the exception and not the rule, we almost invariably find bovine tuberculosis rampant. In milder climates, where animals have free access to fresh air, as, for instance, among the Hereford cattle in England, it is a rare thing to find a case of that disease. On the ranges tuberculosis is unknown, except where it has been introduced by some pampered stable-bred individual, and even such a one is more likely to recover than to die, provided the malady is not too far advanced and the first winter can be endured. To put the case plainly, stockmen are breeding tuberculosis a great deal faster through neglect of this important subject of ventilation than it would ever be possible to stamp it out by the promiscuous use of tuberculin and the slaughter of diseased animals.

I may be pardoned if, while on this subject, I refer briefly to an experiment which I have been carrying on for the last three years. A herd of forty-three cattle (twenty-one being dairy cows), twenty-eight of which had reacted to tuberculin, the remaining fifteen being apparently free from disease, has been kept under open-air conditions since the fall of 1905. The objects of this experiment, which is of a purely practical nature, are threefold: first, to ascertain the effect of open-air treatment upon the diseased cattle themselves; second, to ascertain to what extent healthy cattle, kept in contact with diseased cattle under open-air conditions, are subject to infection; third, to ascertain what percentage of healthy calves it is possible to rear from diseased cows, kept without any precautions under open-air conditions. The experiment is not yet concluded, nor have its results been properly tabulated for publication. I may say, however, that of the twenty-eight reactors, one only has broken down from generalized tuberculosis during the three years which have elapsed since the experiment began. One other has been killed owing to tuberculosis of the udder. Of the healthy animals kept in contact with them, feeding from the same racks, grazing over the same ground, drinking from the same pool, not a single one has become affected, and this in spite of the fact that from time to time animals suffering from acute generalized tuberculosis have been introduced to the herd and allowed to mix freely with its original members.

The results in the rearing of healthy calves, however, remind one somewhat of the Irishman's pigs, which, you will recollect, when killed, did not weigh as much as he expected, and he never thought they would.

Of the calves dropped and reared by reacting cows, 75 per cent. have so far entirely failed to react, while 25 per cent. have reacted at various ages ranging from four months to one year. One calf died at six weeks old from generalized tuberculosis, this case being probably congenital.

The results of the various tests of the original reactors, made at intervals of about six months, and in the last case after a lapse of twelve months, are exceedingly interesting, and will, when published, together with the post-mortem notes, merit the careful perusal of those who believe in the absolute reliability of tuberculin as a diagnostic agent.

I might add that the cattle have had no shelter but open sheds, and have, with exception of a few of the weaker individuals, been fed nothing but hay for the three winters during which they have been under observation.

It should be mentioned that through an error in judgment on the part of an overzealous herdsman, during the first winter our calves began to arrive in December of 1906, the first being dropped when the thermometer was 29 degrees below zero, the others following at intervals, sometimes very short, until the middle of March, 1907, and that in spite of this both dams and progeny throve well in the open air.

The results are very interesting, in view of the present tendency to consider the digestive tract the most frequent and certain channel of infection. While the experiment above outlined assists in proving that young animals can be and are most frequently infected through the digestive system, it also, to my mind, shows that in the case of adults infection through the air-passages plays an important part.

I feel satisfied, and I think all practical men will agree, that had the healthy cattle in this experiment been kept under ordinary stable conditions with their diseased companions, they would not have escaped as they have done.

The highest medical authorities are nowadays advising, and with the very best possible results, our modern hot-house humanity to get "closer to nature" in every possible way. The advantages of adopting a similar policy in the handling and housing of domestic animals are too apparent to admit of discussion. Nature has furnished our animal friends with every conceivable requisite for protection against ordinary climatic conditions, and most of the diseases and disabilities to which they are subject have been caused by, and owe their continuance to, the irrational artificial conditions imposed upon them by well-meaning but ignorant, or rather unthinking, owners and attendants.

I am here, however, to learn and not to teach. The problem of the control of bovine tuberculosis is undoubtedly the most serious confronting the veterinary sanitarian of to-day, and if the labors of this Section of the International Congress result in its solution, I for one will be forever grateful.

DISCUSSION.

Dr. Butler: There was one point made in the last paper regarding the open-air treatment for tuberculous animals. I think it may be of

interest to recite an experiment in which an attempt was made to control tuberculosis in a herd. The animals were tuberculin-tested and the reacting animals slaughtered. Two or three subsequent tests were made, and again all the reacting animals removed. One of these animals afterward began to show evidence of ill health, and was finally dried up and placed in the open with a herd of 33 head composed of non-reacting dry cows and young beef cattle from two to three years old. After remaining with these cattle for about three months, she was still showing evidence of disease. The tuberculin test was applied and she reacted. These cattle were kept in the open air, during which time they were well fed and received some grain. In making a later test of the animals which failed to react we got 13 reactions out of 33 head of cattle, and on post-mortem examination these 13 animals were found to be tuberculous. We condemned one of them as being unfit for human food. Now, I can hardly accept the speaker's statement that open air will prevent the development and spread of tuberculosis. There was absolutely no indoor exposure to this particular cow. When the test was first made of these 33 animals, they were inside. They were put out about two months afterward, but while in the stable they were not exposed to this particular cow.

Dr. C. C. Hayden: I think we often make too much of this open-air and outdoor life. I had a similar experience with some animals in which I found that the disease was transmitted in the open air just the same as indoors.

Dr. White: I feel that in Ohio there are two things which are doing more to disseminate tuberculosis than anything else. One is the indiscriminate use of tuberculin, which is being applied by some farmers of that State, by which the unscrupulous farmers inject their animals with tuberculin before selling in order to deceive the buyer, and this is practised by men who own some of the largest herds. Another thing is this fallacy of fresh-air treatment. The fresh-air treatment, in my opinion, is not very beneficial to the animals in preventing the development of tuberculosis. Cattle, whether tuberculous or not, are generally from eight to ten months outdoors, and besides there is usually in the poorest barns sufficient ventilation through the doors, windows, large cracks, and otherwise by which plenty of fresh air is supplied to the animals. I can cite you instances of the dissemination of tuberculosis under these open-air conditions. I do not think that Dr. Rutherford believes as he says in this matter. I know that his method of dealing with a very similar disease in horses is opposed to the method which he advocates for the suppression of tuberculosis. At Columbus, Ohio, we tried the open-air method, and I will not go into the details more than to say that the disease increased by this method. In a combination with the Bang method we increased tuberculosis in our dairy herd in one year's time from 5 to 38 per cent.

Dr. Rutherford: These gentlemen are laboring under a misunderstanding. I do not believe that the open-air treatment is a cure for tuberculosis. I do say, however, that fresh air is a good thing for cattle—that is all I said in my paper. I did not say that tuberculosis was cured and prevented. I am advocating fresh air as a valuable thing in the case of tuberculous animals.

Dr. Richer (Canada): I have listened to the paper of Dr. Rutherford with a great deal of interest, and I am proud to say that I am also of the opinion that fresh air is a very beneficial thing for tuberculosis in animals. I am glad that this point was brought out, and also the careless manner in which tuberculin is used. I would suggest that more experiments be carried out with the open-air treatment in order to obtain definite data on that important point. I am convinced that these questions are most timely, and undoubtedly show that Dr. Rutherford has given the matter study and observation. His conclusions are very practicable. The point which I wish to bring out is with reference to ventilation and the possible application of the open-air treatment as a preventive and not as a curative method. Near the borders of his own State experiments have been going on for years, and I think Dr. Higgins can tell you something of the experiments, which were carried on with success. There is no reason why the problem should not be experimented with officially by some of the departments of agriculture with the view of fully testing that theory. When we find cattle affected with tuberculosis, it might be advisable to experiment with this fresh-air treatment in the stable.

Dr. Bryce (Canada): There is a side of this question which has not been approached and which I had hoped would be discussed. Two questions are involved: One is a commercial question as to the curability of tuberculosis in cattle of valuable herds. Another is what should be recommended to State and municipal officers of health as practical measures for protecting children from tuberculous milk of the dairies. Can we expect some practical suggestions as to methods which could be put in force by municipal boards of health with regard to licensing dairy herds which supply town milk, or some method of separating from these herds the cows which are tuberculous? What have we of practical methods to be submitted? What practical methods can this Section suggest with regard to protecting the people, and are there any known measures, in addition to the fresh-air treatment, for protection against tuberculosis in dairy herds?

Dr. Nelson: Dr. Rutherford has taken a very strong stand of conservatism. In my opinion it is a little too strong, because, although we know that conservatism is a strong factor in doing all kinds of work, yet a little radicalism prevents us from going backward. He stated that he was waiting until he saw that other countries were meeting with success in the control

of tuberculosis, and that he was going to let other people make the mistakes. Suppose we all did this, what progress would be made? I have made mistakes myself simply because I tried to progress, and possibly too fast, but I think the best progress I have made is due to the mistakes, to a great extent. I am quite sure that Dr. Rutherford would have no man serving under him unless he was a progressive man and liable to mistakes. I believe that the compulsory tuberculin testing of herds has been a mistake, but it has been an advantage to all of us. The more people, the more farmers, we can get to voluntarily request us to test their herds, the better off we are. My experience has been that in getting one good man to test his herd he will exert favorable influence upon his neighbors. I think that by educating the farmers in this respect they will seek our assistance, and in this way more satisfactory results will be obtained.

Dr. Mayer (Louisiana): I have always been an ardent protagonist of the Bang system as affording the only rational solution of the problem of eliminating tuberculosis from dairy herds and preventing the enormous economic loss which would follow a wholesale slaughter of all reacting animals; hence in revising the sanitary code of Louisiana, I included the Bang system. Later, on consulting veterinary experts, I was forced to recognize the truth of Dr. Rutherford's assertion that it requires infinite pains,—more than the average farmer on this side is willing to give,—so the following modification was added to the code, which it seems to me is practical, relieves the individual farmer of the trouble of eliminating tuberculosis from his herds at the minimum of loss, preserves high-grade stock, and protects the public health by the exercise of coöperative efforts:

N. *The Bang Method of Reducing and Eliminating Tuberculosis in Dairy Herds.*—(1) Every owner of a dairy herd supplying milk to the public must have his cattle tuberculin-tested, and all reacting animals in bad condition must be slaughtered. The reacting animals that show no physical evidence of disease must be isolated, and may be kept for breeding purposes.

(2) The offspring from the reacting cows must be promptly removed from their dams, and fed milk from non-reacting cows or the pasteurized (heated to a temperature of 165° F.) milk from the reacting ones.

The milk of the isolated cows, after pasteurization, may also be used for human food and sold, providing the purchaser is duly acquainted with the facts.

(3) If any of the isolated cattle give evidence of enlarged glands, or emaciation or other evidence of the disease advancing, they must be slaughtered.

(4) The non-reacting animals must be tested at least twice a year at intervals of six months, and if any individuals react, they must be placed with the isolated ones.

(5) The calves which are raised from the reacting cows, and which fail to react to tuberculin, may be placed in the sound herd.

(6) The isolated cattle may be fattened and killed under proper inspection for beef, providing the evidence is clear that the disease is localized.

Whenever any municipality, ward, parish, or other political subdivision of the State deems it impracticable or too expensive to carry out the provisions of the preceding sections, they may, if they so elect, through the town council or police jury, establish:

(*a*) A breeding farm for the purpose of segregating all cows in said community reacting to the tuberculin test, but which exhibit no physical evidences of the disease;

(*b*) Or cows which possess special breeding qualities and in which the tuberculous infection has not sufficiently progressed to interfere with their usefulness as breeding stock;

(*c*) Said farm to be provided with a pasteurizing plant and to be under the supervision of the municipal or parish board of health;

(*d*) The manager, if possible, to be a veterinarian, or at least one versed in the Bang method of eliminating tuberculosis in herds;

(*e*) The division of proceeds accruing from sale of cattle, or their increase to take place annually and the proceeds of the milk sales to be divided quarterly;

(*f*) The municipality or parish retaining a percentage based on the actual per capita expense of keeping, housing, and feeding the stock; the owner receiving the balance in money, if he so desires, at the market value of the stock at the time of sale;

(*g*) Or he may let the increase of stock remain on the farm to be kept for breeding purposes, or for sale, as the management may deem advisable, for all interests concerned;

(*h*) All other cows, except those hereinbefore mentioned in which the physical evidences of tuberculous infection are apparent, must be killed;

(*i*) If killed by the kosher method and inspected by a veterinarian or by an inspector trained in the physical appearance of tuberculous meat, the meat may be sold for human consumption, if otherwise free from disease, provided, first, that the infection is localized; second, that the purchaser is duly acquainted with the fact that it is meat from a tuberculous animal; third, that it is sold from a stall from which none other than this class of meat is sold; fourth, the proceeds of the sale of the meat, hide, and trimmings, less the actual cost of inspection, killing, and selling, must be paid over to the owner; fifth, nothing herein contained is to be construed as preventing the establishment of coöperative farms, or even private farms on the same system, providing they are under the supervision of a resident inspector of the municipal, parish, or State health authorities.

Dr. Wladimirof (Russia): I have absolute confidence in tuberculin, and in my experience I have found that by careful usage it renders very valuable service. We have no law compelling the use of tuberculin in my country. The government furnishes the assistance to those desiring to have the test made. When our people once get control of the disease in a herd, they make an effort to keep that herd free from the disease by applying the test year after year. By careful use and observations I have made no mistakes in the use of tuberculin except where the disease was very far

advanced. In the discussion of this subject two questions, one pertaining to the hygiene, the other to the diagnosis, should be kept distinctly separated.

Dr. Rutherford: I would like to ask that the members of this Section be a little more charitable. If they will reconsider the contents of my paper, they will find that it is remarkable for its absence from recommendations, as I did not have anything to recommend. I am waiting for information and knowledge. Referring to the remarks of my friend from Washington State, I am quite willing that he go on making mistakes—I want everybody to go on. That is one reason why I have been watching other people. If I were to make a mistake in a policy which extended over Canada, I think that in about six months there would be nothing of me. I want to listen and learn, and I am waiting for people who know more than I do to make mistakes. I am not opposed to the tuberculin test, and I say this in the light of many years of experience. The tuberculin is undoubtedly reliable in the first test, provided there has been no underhand attempt to interfere with it. Tuberculin is an almost infallible diagnostic agent for tuberculosis. Professor Bang says that it is not infallible, but almost so; but when you come to the second, third, fourth, or fifth test in the same herd, I do not consider it at all reliable. I can show records in my office of tuberculous animals that have reacted under honest conditions, that have failed to react, and have again reacted, and again failed to react. Under these conditions I say that we cannot depend absolutely upon tuberculin in the second, third, fourth, or fifth test. I wish to call attention also to the importance of clinical evidences and symptoms in diagnosing this disease. We are losing the practical side of the question when we lose sight of the clinical aspect of diagnosis. Is there a man in this Section who can say that it is right and proper for Canada or any other country to base legislation on the tuberculin test? I am not prepared, under existing conditions, to assume official control and take legislative action on the authority of the tuberculin test alone at this stage of our knowledge. I want something more definite. If we can get clinical cases in a herd, then we can take legislative action against that herd. We then have evidence of the existence of the disease there.

At the conclusion of this discussion the Section adjourned till half-past two o'clock.

SECTION VII.

Tuberculosis in Animals and Its Relations to Man (*Continued*).

EIGHTH SESSION,

Friday, October 2, 1908.

CONTINUING THE DISCUSSION OF THE CONTROL OF TUBERCULOSIS IN ANIMALS.

The Section was called to order by the President, Dr. Leonard Pearson, at half-past two o'clock.

HISTORY OF THE AGITATION AGAINST BOVINE TUBERCULOSIS IN MASSACHUSETTS,

RESULTING LEGISLATION, AND LESSONS TO BE DERIVED FROM THE ATTEMPTS OF THE STATE TOWARD ITS ERADICATION AND CONTROL.

By Austin Peters, M.R.C.V.S.,
Chief of the Cattle Bureau of the Massachusetts State Board of Agriculture.

Massachusetts was one of the first States, if not the first, to enact legislation for the eradication and control of contagious animal diseases; if not the first, she was certainly the first to enact laws that were effective, as a cattle commission was appointed in 1859 to stamp out contagious pleuropneumonia, which had been imported from Holland in a herd of Holstein cattle and spread to various parts of the commonwealth, and these efforts were crowned with success, the disease being extirpated within her borders by 1865. Other States where contagious pleuropneumonia existed seem to have been incapable of accomplishing this result, and it was not stamped out in other localities where it had obtained a foothold until the United

States Bureau of Animal Industry was organized and the Federal authority took charge of the matter. It was only natural, therefore, that Massachusetts should be one of the first States to enact legislation for the suppression of bovine tuberculosis, and a brief history of the campaign, with the lessons to be derived from it, may be of interest. But first it seems essential to give a short account of the history of the agitation against this disease, which finally led to the adoption of legislation including it among the diseases of animals recognized by law as contagious.

To the late Dr. Noah Cressy, of Hartford, Connecticut, is due the credit of the first attempt to call the attention of the agriculturists of Massachusetts to the nature, importance, and seriousness of bovine tuberculosis. As a speaker at several farmers' institutes in western Massachusetts in the winter of 1879 and 1880 he delivered several lectures upon this disease, which were reported in the "Springfield Republican" in January and February, 1880. His addresses created quite an excitement for the time being among farmers in the localities where these institutes were held, but attracted little attention beyond this, and the excitement soon subsided.

The report of the first farmers' institute at which Dr. Cressy (who at that time resided at Amherst) spoke is given in the "Springfield Republican" of January 30, 1880. The article is headed "A Rural Sensation," and is an account of a meeting held at Warren the previous day, where he gave a lecture on "the diseases of farm animals," among them tuberculosis in cattle. Among other statements he made was that the herd of cattle at the Massachusetts Agricultural College was infected with tuberculosis, and that the trustees were allowing cattle of various pure breeds to be bred there, and permiting the progeny to be sold to the farmers of the State for the purpose of improving their stock, whereas in reality animals were being sold to them infected with a dangerous disease, which was being thus disseminated among the herds of the commonwealth.

A sensation was created during the lecture by the appearance of a Mr. Paige, of Hardwick, in a wheeled chair, who told how he bought three Ayrshire heifers from the Agricultural College in the spring of 1877; that in November, 1879, he had one killed for beef and found her badly diseased, and that he attributed his paralysis and also a blood poisoning in his children to the use of the milk from these heifers. He also showed specimens from the side of one of these heifers, which Dr. Cressy said were lesions of tuberculosis of long standing. Dr. Cressy gave it as his opinion that Mr. Paige's paralysis and the sickness in his children might have been caused by the use of milk from tuberculous cows.

Dr. Cressy also referred to an auction sale of cattle at the Agricultural College the previous summer, and the possible harm to the herds of the State by the dissemination of these animals.

The report of the meeting also conveys the idea that Dr. Cressy, who had formerly been professor of veterinary science at the Agricultural College, had severed his connection with the institution on account of differences of opinion between himself and some of the members of the faculty upon the question of bovine tuberculosis. The "Springfield Republican" of January 31, 1880, quotes Prof. Levi Stockbridge, who had been at the college thirteen years, as saying that the college never bred an animal that had tuberculosis there or developed it within two years of the time it was sold; furthermore, that the statement that Dr. Cressy left the college because he disagreed with some of the faculty on the presence of tuberculosis in the college herd "is an unmitigated and outrageous falsehood." Professor Stockbridge is also reported as saying that "the disease is only consumption, and may attack any breed of cattle in any part of the country; that the milk is healthy until the animal's constitutional vigor is utterly reduced; and that Mr. Paige's statement that the milk gave him paralysis is preposterous."

In the "Springfield Republican" of February 4, 1880, is a short editorial advising that the college authorities should court a most searching investigation, with a view either to disproving Dr. Cressy's assertions, or, if true, to setting matters right.

The "Springfield Republican" of Friday, February 6, 1880, has an account of a farmers' institute at the town hall in Brookfield the previous day. This meeting was largely attended, as Dr. Cressy's previous lecture at Warren had attracted a good deal of attention. Prof. Levi Stockbridge, who was professor of agriculture at the Massachusetts Agricultural College, was present and took the platform early in the proceedings. He had a newspaper with a report of Dr. Cressy's previous lecture in his hand, and read passage after passage of Dr. Cressy's statements concerning the college herd and the sale of diseased animals from it, and asked him as he read each sentence if he (Dr. Cressy) ever made any such statement, and as each question was asked Dr. Cressy, very red in the face, would shake his head. As a matter of fact, Dr. Cressy's statements concerning the condition of the college herd and the danger to other herds by the introduction of cattle from it into them were correct. At that time a cat could not be kept in the cattle barn at the Massachusetts Agricultural College without developing a cough, becoming emaciated, and pining away in a few months. Dr. Cressy should have maintained the position he took at first, but evidently lacked the courage to do so. After Professor Stockbridge finished his remarks, Dr. Cressy gave a very good talk upon bovine tuberculosis, its nature, and the danger from it to the herds of the State, refraining, however, from any allusion to the condition of the herd at the State Agricultural College.

This seems to have been the end of the agitation regarding bovine tuberculosis in Massachusetts, so far as Dr. Cressy was concerned. What he said

did not carry a great deal of weight, for the reason that the farmers thought him a disgruntled individual who was endeavoring to injure the college because he had been dismissed from the faculty a few years before, at a time when the trustees of the college had to economize and decided that the position he held could better be dispensed with at the time than any other. If it had not been for the prevailing idea that he was airing a grievance, which discredited his endeavors, much good might have come from the agitation he started. Cressy's ideas were evidently largely taken from Walley's "Four Bovine Scourges," and were decidedly in advance of the times. Walley, in his "Four Bovine Scourges," published several years before Koch's famous discovery, includes tubercle with the other three great contagious diseases of cattle, viz., contagious pleuropneumonia, foot-and-mouth disease, and rinderpest. In the preface to his work he speaks of these four diseases as being of "more importance to the stock-owner than all the other ills to which bovine flesh is heir." He also says that while "the three first-mentioned diseases are only too well known, the last (tubercle) is less perfectly so, even, it may be said, to the veterinary surgeon."

Walley in his work expresses his belief in the communicability of tuberculosis from one animal to another, his belief in the danger to man from the use of milk and meat from tuberculous animals, and his opinion that tuberculosis is identical in man and the lower animals. He quotes from the experiments of Vellemin, Gerlach, Viseur, Grad, Zundel and other veterinary and medical authorities in support of his views.

Dr. Cressy, in his lectures at the farmers' institutes, simply voiced Walley's opinions, and the views he expressed then were no less true or different from the views held by many scientific men at the present time, but which were not then generally accepted as true by the medical profession, because they lacked the conclusive proof later announced by Koch when he made known to the world his famous discovery of the tubercle bacillus. There were a few faint echoes following the agitation started by Cressy, although nothing more was heard from him personally. The "Springfield Republican" of Monday, February 9, 1880, mentions the report of the trustees of the Massachusetts Agricultural College for the year. The part relating to the college herd reads in part as follows: "that from the most thorough investigation we have been able to make, the statement that disease has been propagated by the sale of cattle from the college farm is absolutely false, and we ask that the matter be referred to the commissioners of contagious diseases for a most rigid investigation." (Professor Stockbridge was professor of agriculture at the college, and one of the cattle commissioners at this time.)

The cattle commissioners, in their report to the legislature of Massachusetts, January 7, 1881, refer for the first time to bovine tuberculosis. The

report mentions the commission being called to visit a herd in Grafton, Worcester County, where a number of cattle were found suffering with this disease, and also mentions the fact that the disease had been found in three or four other isolated localities within that year. It says:

"It has been the occasion of much excitement and alarm by sensational statements of its contagiousness. That it is so, the best authorities are not agreed. Yonatt, in his work on cattle published in 1840, says: 'Animals which exhibit decided symptoms of consumption should be removed from the dairy, not because the disease is contagious, but because it is undeniably hereditary.' Recent experiments have been made to test the contagiousness of tuberculosis, both by inoculation and the ingestion of tuberculous matter; and Fleming says, 'The facts elicited affirm that it may be thus communicated.' Several investigators in this direction have failed to produce corroborating results, and others say that no results have yet been reached of any value in this direction.

"The question of the contagiousness and virulence of tuberculosis is still under consideration, and further researches are necessary to elucidate and establish certain important points respecting it. We have, therefore, declined to consider it within the intent of the law which prescribes our duties and obligations. During the excitement occasioned by the supposed prevalence of this disease, a report reached the Board of Agriculture that the cattle on the Agricultural College farm at Amherst were infected with it, and the members, in their capacity as overseers of the college, passed a resolve requesting the commissioners to make a careful examination of the stock and its condition. Complying with this request, Dr. E. F. Thayer, the veterinarian of the Board, made the examination, and reported to the overseers that 'the appearance of the animals, without exception, was that of perfect health. Not one could be found that required physical examination; percussion and auscultation were tried on one without eliciting other than a normal and healthy condition.'"

The above is a portion of the annual report of the cattle commissioners, dated January 7, 1881. This portion of their report for 1880 is here given in detail because it seems to be the first official recognition, or a declination to recognize, tuberculosis among cattle in Massachusetts, and this communication from the cattle commissioners was in reality the result of Dr. Cressy's agitation of the matter the previous winter.

The late Prof. Levi Stockbridge, and also the late Dr. Josiah H. Stickney, of Boston, have informed the writer that during the campaign against contagious pleuropneumonia in 1860 to 1866, occasionally cases of bovine tuberculosis were met with, but little attention was given to them; the cattle commission was stamping out contagious pleuropneumonia, and this disease was not contagious pleuropneumonia, was not known to be contagious, and therefore little thought was given to the few cases met with.

In their report to the legislature dated January 10, 1882, the cattle commissioners, speaking of lung diseases in connection with contagious

pleuropneumonia, write as follows: "Inflammation of the lungs, or tuberculosis, may be engendered in the stock of any farm by undue exposure, want of ventilation, or confinement in damp and filthy inclosures. But contagious pleuropneumonia, which has symptoms resembling those diseases, is the result of contact with an animal possessing the infection, or with some object he has infected, and is disseminated from animal to animal, like smallpox or measles in the human family. The appearance of lung disease on remote and isolated farms, unless it can be traced to contact with animals from abroad, should cause no alarm, but should prompt the owners to a careful hygienic examination of their premises and methods of stock management."

There is no further mention of bovine tuberculosis by the Massachusetts cattle commissioners in their reports for four years, but there was a lecture read at the public winter meeting of the State Board of Agriculture at Framingham, in December, 1885, upon "Tuberculosis in Cattle," prepared by Dr. Frank S. Billings, of Boston, who unfortunately was not present to deliver it in person, hence there was little discussion of the paper. As this lecture was given after the discovery of the tubercle bacillus by Koch, it was more in accordance with modern ideas than the statements in the former reports of the cattle commission. Space will not permit a résumé of this paper, but it can be found in the report of the Secretary of the Massachusetts State Board of Agriculture for 1885.

In June, 1885, the personnel of the Massachusetts Board of Cattle Commissioners was changed: Dr. Thayer and Mr. Jordan retired, and Mr. A. W. Cheever, agricultural editor of the "New England Farmer," and Dr. J. F. Winchester, a young veterinarian of Lawrence and a graduate of the Massachusetts Agricultural College, were appointed to replace them, and Professor Stockbridge was continued in office.

At a special meeting of the State Board of Agriculture, held at the town-hall at Barre, Mass., November 29, 1886, called at the request of the cattle commissioners, Dr. Winchester addressed the meeting, calling attention to the presence of bovine tuberculosis in the State, its heredity, transmissibility, and insidiousness, and the difficulty of the diagnosis, and his inability to assist owners of infected herds under existing laws. He was followed by Professor Stockbridge, who stated that the Board of Cattle Commissioners had long known of the existence of bovine tuberculosis in Massachusetts, but that the veterinary colleges had never agreed upon the question as to whether it is contagious or not. "There has been a long and acrimonious dispute in relation to it, and the consequence has been that the cattle commissioners have never recognized it or treated it as a contagious disease." After considerable discussion it was decided that if additional legislation regarding it was necessary, the cattle commissioners were the ones to recommend it to the legislature and to attempt to procure it. The cattle com-

mission, in its report to the legislature, January 7, 1887, refers to tuberculosis among cattle, its nature and dangers, and in conclusion says: "Notwithstanding all that is certainly known of the disease and the great losses it entails, yet it is surrounded with such obscurity and uncertainty, and presents such apparently insurmountable obstacles to its eradication, that we have made no direct attempts to combat it; but some of our citizens, to rid their herds and premises of the pest, have, during the past year, destroyed many thousands of dollars' worth of cattle."

If the cattle commission made any attempt this year to obtain legislation on bovine tuberculosis, nothing came of it. In their report of January 6, 1888, for the year 1887, the cattle commissioners again speak of the prevalence of tuberculosis among cattle, its peculiarities and the difficulty of eradicating it "by force of our present statutes or any appropriation the legislature would make." It says the disease prevails to about the extent of the previous year, but suggests that as the veterinary profession increases in number "attention is called to it more and more, and there is a call for more active work."

In the report of the cattle commission of January 7, 1889, for the year 1888, there is a special report by Dr. J. F. Winchester upon tuberculosis, showing by tables its prevalence and losses in certain herds to which his attention had been called. In 1889 Dr. Winchester's term expired, and the late O. B. Hadwin, of Worcester, was appointed to the vacancy.

Tuberculosis among cattle had now attracted so much attention that it could not be ignored. The reports of the cattle commissioners for 1889, 1890, and 1891 give the subject a certain amount of consideration, although the position taken is rather one of not unduly alarming the public or of exaggerating the danger from it. The report for 1891 exhibits considerable ire against the State of Maine for prohibiting the shipment within her borders of neat cattle from Massachusetts because of the prevalence of bovine tuberculosis within the latter commonwealth, and remarks that the action of Dr. Geo. H. Bailey, veterinarian to the Maine cattle commission, is unconstitutional, and quotes a decision of the United States Supreme Court in support of this view, in reference to Missouri forbidding bringing cattle infected with Texas fever within her limits, "because it attempted to interdict or control commerce between the States, which was a power conferred by the Constitution only upon Congress." Since then there have been other opinions of the United States Supreme Court that a State can take measures to protect itself from the introduction of a disease that may endanger the health of its people or live-stock.

Late in 1886 or early in the winter of 1887 the writer of this paper, who was at that time investigating contagious bovine abortion for the Massachusetts Society for Promoting Agriculture, remarked to the late Ebenezer

Francis Bowditch, of Framingham, one of the trustees of the Society, that it would be very interesting to investigate the danger from the use of milk from tuberculous cows. While it was generally conceded that a cow with a tuberculous udder gave off tubercle bacilli in the milk, it was suggested that an investigation to show how slightly diseased a cow might be, and yet be dangerous, might be of value. The trustees of the Society decided that such an investigation would be of value, and decided to undertake the work. The writer, while he was the Society's veterinarian, advised that to make the results of the work carry the greatest possible amount of weight the services of a man who had already made a name as a scientist, and whose signature to a report would secure immediate recognition, should be secured to direct the experiments and prepare a report of the results.

The services of Dr. Harold C. Ernst, of Boston, professor of bacteriology at the Harvard Medical School, were secured for this purpose. A committee of the trustees of the Society for Promoting Agriculture, consisting of the late Thomas Motley, its president, the late E. F. Bowditch, the late Jacob C. Rogers, and General Francis Henry Appleton, was appointed to have charge of the work.

A farm was rented at Mattapan, a suburb of Boston, as an experiment station, in the spring of 1887, where a herd of tuberculous cows was kept for over three years, and feeding and inoculation experiments conducted and bacteriological examinations of the milk and cream made at the Harvard Medical School. Dr. Ernst supervised much of the work and wrote the report, but a great deal of the actual work was performed by Dr. Henry Jackson, Dr. Langdon Frothingham, and the writer of this paper. A report of the results of these researches was presented to the trustees of the Society in the autumn of 1890, and was later published in book form at its expense under the title of "Infectiousness of Milk."

It was found that milk from a herd of tuberculous cows contained tubercle bacilli as demonstrated by both microscopical examination and inoculation experiments, and that milk from these cattle was capable of producing tuberculosis in calves and pigs fed upon it in from 33 per cent. to 50 per cent of the young animals fed. Milk-feeding experiments were tried on rabbits, but with much less positive results, due no doubt to these little animals drinking less milk proportionately to calves and pigs.

Besides the results of the experiments at Mattapan the report contains a voluminous correspondence elicited by letters written by Dr. Ernst asking the views of members of the veterinary and medical professions on the infectiousness of milk, and reports from veterinarians upon the prevalence of bovine tuberculosis in various localities. Dr. Ernst concludes the report as follows:

"I have presented, in the preceding pages, the evidence that we have

been able to collect upon the points in regard to which information seemed to be especially needed. This evidence is sufficient, it appears to me, to warrant certain definite conclusions, as follows:

"1. While the transmission of tuberculosis by milk is probably not the most important means by which the disease is propagated, it is something to be guarded against most carefully.

"2. The possibility of milk from tuberculous udders containing the infectious element is undeniable.

"3. With the evidence here presented, it is equally undeniable that milk from diseased cows with no appreciable lesion of the udder may, and frequently does, contain the bacillus of this disease.

"4. Therefore, all such milk should be condemned for good."

The Massachusetts Society for Promoting Agriculture presented the results of these investigations to the legislature of 1891, on January 13th, by petition asking for legislation to secure an inspection of cattle in Massachusetts. After a delay of several months the legislature passed the following:

"*Chapter 118, Resolves of 1891.*

"Resolve providing for an investigation by the State Board of Agriculture into the dangers arising from tuberculosis in the food-products of cattle.

"*Resolved,* That the State board of agriculture be instructed to investigate and ascertain the best methods to be adopted in order to protect the citizens of this Commonwealth against the dangers to human life and health which may arise from the presence of tuberculosis in the food-products of cattle, with power to employ expert assistance, and report in print the result of their investigations to the next general court, with such recommendations as they may deem advisable. And for the purpose aforesaid, they may expend such sum, not exceeding twenty-five hundred dollars, as they may deem necessary, which sum shall be allowed and paid out of the treasury of the Commonwealth. (*Approved June 11, 1891.*)"

The appropriation provided was much less than was recommended, and was so small as to negative the purpose of the resolve. The State Board of Agriculture reported to the legislature of 1892, in compliance with the requirements of the foregoing resolve, that because of the small amount appropriated, the Board of Agriculture did not think that it could add much to the information already obtained, but it made certain suggestions for legislation relating to bovine tuberculosis, much of which was later incorporated into the statutes of the commonwealth.

Primarily to the Massachusetts Society for Promoting Agriculture belongs the honor of bringing to public attention the prevalence of bovine tuberculosis, and the dangers from the use of meat and milk from tuberculous animals, and it largely deserves the credit for final legislative action. The Massachusetts legislature of 1892, ten years after the discovery by Koch of

the tubercle bacillus, declared tuberculosis to be one of the contagious diseases of animals recognized by the statutes of the commonwealth, and provided for the killing of diseased cattle without appraisal or payment. It also made the law providing for the appointment of inspectors of animals in the various cities and towns of the State mandatory; prior to this it had been permissive since 1876, but only a few municipalities had availed themselves of it. Later the law was amended to provide that these appointments should be subject to the approval of the cattle commissioners; it also provided that the Board of Cattle Commissioners could appoint inspectors of animals where cities or towns refused or neglected to do so, and that they could remove inspectors for incompetency or just cause. In 1893 the legislature also enacted a law providing a penalty for any city or town that refused or neglected to appoint an inspector or inspectors of animals and provisions. In 1908 the legislature passed a law that one of the inspectors of animals annually appointed in cities shall hereafter be a registered veterinary surgeon. As a matter of fact, nearly all the cities and larger towns already had veterinarians for inspectors of animals.

In the spring of 1892, at the request of Gov. Wm. E. Russell, the cattle commissioners, Messrs. Stockbridge, Cheever, and Hadwin, resigned, and the governor reappointed Professor Stockbridge, the old wheel-horse of the commission, and named to serve with him two veterinarians, Dr. Charles P. Lyman, dean of the faculty of the Harvard Veterinary School, and Dr. Maurice O'Connell, a veterinarian living in Holyoke, who qualified May 12th and immediately entered upon the discharge of their duties.

During their first year in office eighty-one head of tuberculous cattle were killed without appraisal or payment.

The cattle commission of three members continued as above until June, 1894, when the Board was increased to five; owing to the increasing interest in bovine tuberculosis and the demand for a greater amount of work it was decided that three men were not sufficient, and that the Board ought to be larger. Dr. Frederick H. Osgood, a professor at the Harvard Veterinary School, and Leander F. Herrick, of Worcester, were appointed. The act of legislature increasing the commission to five members also provided that one-half the value of neat cattle killed by the State authority as tuberculous shall be paid by the commonwealth, the appraisal to be based on the value of the animals for food or milk. In October, 1894, Charles A. Dennen, of Pepperell, was appointed a member of the Board, to fill the vacancy caused by the retirement of Professor Stockbridge, after twenty-seven years' service, who resigned at the end of his term of office. He might have been reappointed for another term of three years, but preferred to relinquish the position, as he had become an old man, and the duties were becoming more arduous and assuming greater proportions than formerly.

In September of 1894 the Board of Cattle Commissioners first introduced the use of tuberculin as a method of diagnosis, and immediately instituted its use upon a large scale. The tuberculin test was applied to all the cattle quarantined on suspicion by the local inspectors of animals, also upon cattle brought into Massachusetts from adjoining States, and a systematic testing of entire herds was undertaken, the commissioners stating that it was their intention to test all the herds in the State and kill reacting animals, starting in the southeast corner. This season the entire bovine population of Nantucket Island was tested, only 0.9 per cent. of the cattle reacting. The assertion that the commission intended a compulsory test of all the cattle in the State aroused a great deal of opposition in some quarters. During the autumn the local inspectors quarantined 3295 cattle on suspicion of being affected with tuberculosis, of which 810 were found to be tuberculous by means of the tuberculin test and killed; 1432 head were tested at Brighton, of which 89, or 6.21 per cent., were killed and found tuberculous, but there were also 21 killed in which no lesions were found. There were 665 tested on Nantucket; only 6 reacted, and the lesions in some of these were so slight as to be questionable. During 1895 the personnel of the commission remained as it was in October, 1894, after the appointment of Mr. Dennen, and the policy adopted the previous autumn continued unchanged in most respects. The payment of half compensation for tuberculous neat cattle destroyed was found to be unsatisfactory to the farmers, and the law was changed to allow the full appraised value for each animal killed, not exceeding sixty dollars for any one creature, provided the condemned animal had been owned in the commonwealth for six consecutive months prior to the date of condemnation.

The cattle commission continued to test all cattle brought to Brighton, Watertown, and Somerville stockyards from without the State, and also all Massachusetts cattle offered for sale at these markets except beeves for immediate slaughter, calves under six months old, and cattle intended for export, until April 30th, when the work was relinquished for lack of funds.

In July an order was adopted that cattle could be brought in from without the State on permits issued by the Board, except to the stockyards at Brighton, Watertown, and Somerville, where they could be brought without permits, as these yards were considered quarantine stations, and cattle accompanied by satisfactory certificates of tuberculin test, made by veterinarians in other States, approved by the Board, were released. This method continued for several years, and soon became a farce and fraud upon the public, as much of the work was done dishonestly, to please the cattle-dealers, particularly for the drovers attending the weekly market for milch-cows at Brighton. The systematic testing of herds started in Nantucket the previous year was continued, and completed in Dukes (the island of Martha's

Vineyard) and Barnstable Counties, including 2856 animals, of which 9 reacted to tuberculin and were killed and found to be tuberculous. In addition, 795 head were condemned as tuberculous that were quarantined by the local inspectors. The cattle commission continued in 1896 as organized in October, 1894, with Dr. Osgood as chairman and Dr. Lyman as secretary, until October.

The commission's position on tuberculosis was very radical and expensive. The inspectors of animals during the first half of the year, before an appropriation was made for the year's work, continued to quarantine cattle on suspicion of having tuberculosis, and the law provided that after ten days from the date each animal was quarantined the State should assume the expense, and the commission would not kill any until an appropriation was made. The result was that when the legislature made an appropriation early in June, there were 1043 head of neat cattle in quarantine upon which the State owed a board bill of $28,223.43—nearly as much as the appraised value of the animals in quarantine.

The avowed intention of the Board of Cattle Commissioners to enforce a compulsory tuberculin test of all the neat cattle in the State aroused a great deal of opposition among the farmers. Tuberculin was a new agent, and as such could not be forced upon cattle-owners until more was known about it by them, as many statements were in circulation concerning injurious effects produced by it, such as causing tuberculosis in healthy cattle, abortion, and the like; furthermore, many owners of cattle were unable to comprehend that an animal with a nodule or two in a bronchial or mediastinal gland was a source of danger to other cattle or to human life, or that the flesh of such an animal was unhealthful for human food. As the result of this opposition Dr. John M. Parker, of Haverhill, was appointed a member of the Board by Governor Wolcott, at the expiration of Dr. Lyman's term of office in October, 1896.

In December Dr. F. H. Osgood resigned and Dr. Austin Peters, of Boston, was appointed to fill the vacancy, and elected chairman, with Dr. Parker as secretary. The excitement over bovine tuberculosis reached high-water mark in 1896, when the legislature appropriated $300,000 for the use of the cattle commission. Early in the winter of 1897 an appropriation of $250,000 was secured for the eradication of contagious diseases among animals. During the spring of 1897 many farmers in Middlesex County had their herds tested by veterinarians at their own expense, and the veterinarians reported reacting animals to the cattle commissioners, who had the animals appraised and killed, leading to a raid on the appropriation by tests on cattle over which the Board had no control.

Another extravagant feature of the law then in force was that animals killed as diseased were deemed unfit for food, and hundreds of animals were

thrown into the rendering tank and made into fertilizer, which under an intelligent system of meat inspection might have been passed as fit for beef.

The farmers who had the testing done in most cases had no interest in an attempt to diminish the amount of bovine tuberculosis in the State, but simply did it as a matter of speculation, with the idea of selling a lot of old milked-out cows to the commonwealth for more than they were worth. In this they were disappointed to a certain extent, as more cows reacted than the owners expected, and also in many instances the best ones, so as to almost wipe out entire herds. This condition of affairs attracted the attention of certain members of the legislature, resulting in the appointment of a special joint committee April 9, 1897, to investigate the work of the cattle commission, with power to employ experts to make autopsies on the cattle from certain herds in Dracut, condemned after private tests made by veterinarians, the committee to report to the legislature later.

The committee selected as experts to make autopsies on condemned cattle, and also the few remaining non-reacting cattle in certain herds, was: Harold C. Ernst, M.D., of Boston; Theobald Smith, M.D., of Boston; Geo. N. Kinnell, M.R.C.V.S., of Pittsfield; Dr. Frank Billings, of Grafton, a graduate of a German veterinary school, and Charles R. Wood, Veterinary Surgeon, of Lowell. Each wrote an independent report.

The legislative committee from the Senate and House reported May 25, 1897. There were two reports, one signed by most of the members, and a minority report signed by two members of the House. The majority report favored more conservative methods, and stated that the cattle commission should pay more attention to disinfecting barns and stables where tuberculous animals had been kept, immediately upon their removal, and before new animals were introduced. The majority report continued as follows:

"From our observations at the investigation we hold that the Board of Cattle Commissioners should at once take into consideration modifications of the law relative to the condemnation of cattle by tuberculin test alone, that is, upon the request of owners of cattle for such testing of their herds. If cattle are to be condemned or regarded as suspicious animals only after they show signs of disease, it is a question as to the propriety or equity of the State paying full value for those that are actually diseased. This proposition we respectfully refer to the consideration of the next General Court, trusting that the Board of Cattle Commissioners will, in the mean time, consider the same question and offer recommendations in their annual report.

"We believe that the legislature should at once deal with the matter of indiscriminate tuberculin tests. We recommend that all testing of cattle with tuberculin when compensation is expected be limited to the cattle commissioners or their authorized agents. The Board of Cattle Commissioners have already expended more than $160,000 of the total appropriation of $250,000 made earlier in the session. If they are compelled to kill all reacting animals and allow full compensation for the diseased cattle, the remainder of the appropriation will soon be exhausted. There will then be no

money for the prosecution of the regular work of the commission or the slaughter of those animals reported by the local inspectors as suspicious cases, and which are really the most dangerous animals to the health and comfort of the general public. The commissioners are not allowed to exceed their appropriation, hence all their work must stop when their money gives out.

"We earnestly recommend the immediate passage of the following act:

"COMMONWEALTH OF MASSACHUSETTS.

"In the Year One Thousand Eight Hundred and Ninety-seven.

"AN ACT

"Relative to the Payment of Compensation from the State Treasury on "Account of Cattle Infected with Tuberculosis.

"*Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:*

"SECTION 1. No person or persons having animals tested with tuberculin shall be entitled to compensation from the State for any animals that react to the tuberculin test unless such testing be done by the State Board of Cattle Commissioners or their authorized agents acting as such at the time of the test, and such testing must be subject to the supervision and control of the State Board of Cattle Commissioners.

"SECT. 2. This act shall take effect upon its passage.

"We submit with this report the reports made by the experts attending the post-mortem examinations of these cattle."

The above proposed legislation was immediately acted upon, and became law June 10, 1897, insuring a complete control in the future to the cattle commission of its appropriations. The legislature had already, earlier in the season, passed an act restricting the use of tuberculin, which provided as follows:

"The use of tuberculin as a diagnostic agent for the detection of the disease known as tuberculosis in domestic animals shall be restricted to cattle brought into the commonwealth from any point without its limits, and to all cattle at Brighton, Watertown, and Somerville; provided, however, that tuberculin may be used as such diagnostic agent on any animal or animals in any other portion of the State upon the consent in writing of the owner or person in possession thereof, and upon any animals condemned as tuberculous upon a physical examination by a competent veterinarian." (*Approved March 15, 1897.*)

This clause in the law was first enacted in April, 1896, to continue in force until June 1, 1897, but in March, 1897, it was made permanent upon the statute-book. This was due to the opposition of the farmers to the unrestricted compulsory use of tuberculin by the cattle commission.

The minority report of the committee favored continued radical action, and considered that if the cattle commissioners had made mistakes, the fault was with them and not with the law.

In 1898 the legislature gave the cattle commissioners "power to make and issue rules and regulations for the guidance of inspectors of animals and provisions in the inspection of meat, which shall conform with the rules and regulations of the United States Bureau of Animal Industry for the inspection of meat for export and for interstate commerce." (*Approved May 23, 1898.*) This put an end to the folly and extravagance of making fertilizer out of meat fit for food. In 1898 only $20,000 was appropriated for the use of the cattle commission. Governor Wolcott called the attention of the legislature to the fact that this appropriation was insufficient to carry out existing laws; the House then voted to abolish the cattle commission, in which the Senate refused to concur. The governor then again wrote the legislature a message recommending a further appropriation; the House again voted to abolish the cattle commission; the Senate again stood by it. The commissioners decided to do what they could as individuals during the remainder of the year, and in this way examined and caused to be killed glandered horses, and kept up the quarantine against out-of-the-State cattle, requiring all those brought in to have certificates of tuberculin tests, except beeves for immediate slaughter or calves under six months old. The legislature of 1899 passed a deficiency appropriation bill sufficient to pay the members of the commission the arrears in their salaries.

The legislature of 1899 also passed an act recodifying the laws relating to contagious animal diseases, reducing the cattle commission from five members to three, and giving it an appropriation of $75,000 for the current year. The limit of value on a bovine with tuberculosis was reduced from $60 to $40, and the law providing for the annual appointment of inspectors of animals and provisions by the various cities and towns of the State was changed to provide for the annual appointment of inspectors of animals. The inspection of live animals at the time of slaughter and provisions was turned over to the local boards of health, the inspectors of animals only having to inspect live animals for contagious diseases, quarantine suspected cases, and make a general inspection of farm animals and premises where they are kept when ordered to do so by the cattle commission.* This act was approved May 25, 1899, and Governor Wolcott appointed Charles A. Dennen, Leander F. Herrick, and Dr. Austin Peters members of the Board.

The commission continued thus until 1902, when, at the suggestion of Governor W. Murray Crane, who thought that the State had too many commissions, the legislature abolished the Board of Cattle Commissioners and established in its stead a Cattle Bureau of the State Board of Agriculture, with a chief appointed annually by the governor with the advice and consent of the Honorable Executive Council, who, by virtue of his office, shall be a member of the State Board of Agriculture. The governor then appointed

* This inspection has been ordered annually in the autumn since 1899.

Dr. Austin Peters chief of the Cattle Bureau. As there is no one in the Cattle Bureau except the chief who has the powers and duties formerly vested in the cattle commission, it practically replaces a commission of three with a single commissioner. This arrangement has remained in force since April, 1902, up to the present time.

During the winter of 1902 and 1903 the market at Brighton was closed because of an outbreak of foot-and-mouth disease, but since it was reopened in July of the latter year all out-of-the-State cattle brought to Brighton, Watertown, and Somerville for the weekly market upon which a test is required have been tested by the agent of the Cattle Bureau in charge of these yards, and his assistants, as it was found that much of the testing outside of the State, which was done by the veterinarians for the drovers, was not honestly performed, and the certificates in many instances were of no value. About 13,000 or 14,000 cattle, chiefly milch-cows, are tested at the Brighton barn each year, and reacting animals—about 200 usually—are killed. Recently it has been decided not to accept any certificates of test from veterinarians outside of the State on cattle coming in on permits to points outside of the stock-yards at Brighton, Watertown, and Somerville, but to have all cattle upon which a test is required tested after arrival at their destinations by agents of the Cattle Bureau. These tests are made free of charge to citizens of Massachusetts, and at cost to others, as required by Chapter 322 of the Acts of 1903.

The following shows the amounts appropriated for the use of the cattle commission or Cattle Bureau since 1895, and the number of cattle killed:

Year.	Amount Appropriated.	Number of Cattle Killed	Amount Paid for Cattle.
1896	$300,000.00	5,748	$182,216.60
1897	250,000.00	5,529	188,534.00
1898	20,000.00	297	8,057.61
1899	75,000.00	785	17,277.69
1900	50,000.00	1,423	30,870.22
1901	50,000.00	1,341	
and a deficit appropriation	3,408.11		27,424.50
1902	58,000.00	1,001	21,137.75
1903	73,000.00		
and a deficit appropriation	4,500.00	1,843	42,454.32
additional appropriation foot-and-mouth disease	40,000.00		
1904	65,000.00		
and a deficit appropriation	9,500.00	1,658	35,456.45
1905	67,000.00		
and a deficit appropriation	5,000.00	1,625	34,133.58
1906	66,416.66		
and a deficit appropriation	11,560.24	1,737	35,952.75
1907	77,000.00		
and a deficit appropriation	8,432.60	2,030	42,326.60
Totals	$1,233,817.61	25,017	$672,842.07

It will be seen by the foregoing table that for the twelve years ending December 1, 1907, the State of Massachusetts has appropriated the sum of $1,233,817.61 for the eradication and control of contagious diseases among domestic animals, and that a large item of expense is the cost of paying owners of tuberculous animals for neat cattle slaughtered by the State authority as suffering from this disease. During twelve years 25,017 head of tuberculous cattle have been killed, for which the State has paid $672,842.07—an average of $26.89 per head.

It is also shown how the pendulum has swung one way and then the other; that in 1896 the limit was reached when $300,000.00 was appropriated, and in two years the legislature went to the other extreme and appropriated but $20,000.00; and that the House then voted to abolish the cattle commission; how later an even keel was reached, and since then the appropriation has ranged from $50,000 to $75,000 per year. The combined appropriations for the years 1896 and 1897 were nearly half of the sum of the appropriations for the twelve years, and $377,750.60 was paid for 11,277 diseased cattle in 1896 and 1897, which is more than half of the sum total paid for 25,017 head.

The average price paid per head for condemned animals in 1897 was a little over $34, which was the maximum average price per head reached; since then it has been diminished, until the last few years the average price paid per animal has been between $20 and $21. The reason for the high prices paid in 1896 and 1897 was due to the fact that all animals quarantined by the local inspectors and many large herds were tested with tuberculin, and all reacting animals killed, no matter how slightly diseased they might be, and many of these animals were apparently in good physical condition, while at the present time very little herd testing is being done; as a rule, only animals that show marked physical evidence of disease, or that have nodulated udders, are killed, and nearly all are condemned on a physical examination. In 1896 and 1897 there must have been, counting private tests, fully 10,000 head of cattle tested with tuberculin in each year, over half of which reacted and were killed and found to be diseased.

At present herd tests are made only on the following conditions: that is, they are made with the understanding that reacting animals are to be killed if the owner will agree to accept what the butcher will allow for those that are so slightly diseased as to pass as fit for beef, the State to pay for those that are so badly diseased as to have to be rendered, the State furnishing the agent to do the testing and the tuberculin free of charge to the owner of the herd. The owner also further agrees to purchase only tested animals in the future, and to cleanse and disinfect his stables in accordance with the rules and regulations of the Cattle Bureau. This puts part of the burden of expense on the owner of the herd, and a farmer does not care to request to have his herd tested unless he is thoroughly in earnest in his desire to eradicate the disease

from his premises. In 1907 only 16 herds were tested at the request of owners, comprising 454 animals. Three hundred of these failed to react. and 126 passed for beef to the credit of the owner, the State not having to pay for them. Only 26 were so badly diseased as to have to be rendered. Two reacting animals were held in quarantine for further observation.

The present methods give the State a tolerably good system of dairy inspection as far as the public health is endangered from the milk of tuberculous cows in Massachusetts, but it does not protect them from the milk of tuberculous cows in Maine, New Hampshire, Vermont, Connecticut, or New York State.

It is doubtful if the work at present being carried on against bovine tuberculosis in Massachusetts accomplishes much in the direction of decreasing the percentage of tuberculosis among the herds of the State, as a fresh crop of badly diseased cattle, mostly cows, is harvested year after year; if anything, it would appear that there is a slight increase, as the number of condemned cattle has gradually increased a little, varying somewhat from year to year, from 1423 in 1900 to 2030 in 1907. To do more work and gain greater headway larger annual appropriations for the use of the Cattle Bureau will be needed; the greatest possible amount of work is being done with the means available at the present time. If public opinion demands more than is at present being done, there is no doubt but that the appropriations will be increased so as to allow more active and extensive measures being adopted for the eradication and control of bovine tuberculosis than are at present in force, but it is not at all likely that the commonwealth of Massachusetts will ever return to annual appropriations for this purpose of from $250,000 to $300,000.

At the present time we are hearing a great deal about the new era in medicine, and the great field of preventive or State medicine; while it is new to many, it is not so new to us; the veterinary profession had a very good conception of preventive medicine and of sanitary science and police at a time when the practice of medicine to the minds of many consisted only in going into a sick-room, looking wise, making a diagnosis, and writing a prescription. Veterinarians can point with pride to the fact that they are the pioneers who have blazed the path through the wilderness, built the roads, and constructed the bridges over which the main army is now so eagerly rushing into the field in which "medicine is coming to her kingdom."

Histoire de l'Agitation contre la Tuberculose bovine dans l'Etat de Massachusetts; Législation qui en est résultée, et Leçons que l'on peut tirer des efforts faits par l'Etat pour l'extirper et la controler.—(PETERS.)

Cette étude traite du début de l'agitation dans l'Etat de Massachusetts contre la tuberculose bovine; la première tentative fut une série de confér-

ences faites en 1880 par le docteur Noah Cressy, qui habitait alors à Amherst, Mass. Il fit ces conférences à l'Institut des Agriculteurs, empruntant les idées évidemment en grande partie de l'ouvrage de Walley "Quatre fléaux de l'espèce bovine." L'étude donne un compte-rendu des efforts du Dr. Winchester en sa qualité de membre de la Commission du Bétail, pour faire reconnaître la tuberculose bovine par les lois de l'Etat, ce qui fut fait plus tard après la découverte du bacille tuberculeux par Koch. Elle contient aussi un court résumé du travail exécuté par le Docteur H. C. Ernst et moi, sous les auspices de la Société de Massachusetts pour l'Avancement de l'Agriculture; le rapport du Dr. Ernst à cette Société, et les démarches de la Société qui attira l'attention de la Législature de l'Etat sur cette question en 1891; le fait que la tuberculose chez les animaux fut reconnue comme maladie contagieuse par un acte législatif de l'Etat de Massachusetts en 1892; et enfin l'histoire des travaux de la Commission du Bétail et du successeur de la dite Commission, le Bureau du Bétail, dans ses efforts pour diminuer et contrôler cette maladie, de 1892 jusqu'aux temps présents.

Geschichte der Agitation gegen die Rindertuberkulose in Massachusetts, daraus erfolgende Rechtsgebung, und Lehren, die man von den Versuchen des Staates in Bezug auf ihre Ausrottung und Kontrolle ziehen kann.—(PETERS.)

Dieser Artikel erörtert die frühzeitige Agitation in Massachusetts gegen die Rindertuberkulose, wobei das Erste eine Reihe von Vorlesungen im Jahre 1880 bei Dr. Noah Cressy war, welcher damals ein Bewohner von Amherst, Mass., war. Er hielt die Vorlesungen in dem Farmer-Institut, wobei er offenbar die meisten seiner Ideen von Walley's "Four Bovine Scourges" nahm. Der Artikel giebt dann einen Bericht von Dr. Winchester's Bemühungen als ein Mitglied der Rinderkommission, die Anerkennung der Rindertuberkulose durch Staatsgesetze zu sichern, welches später und nach der Entdeckung des Tuberkelbazillus durch Koch geschah. Er giebt auch ein kurzes Résumé der Arbeit geleitet unter den Auspizien der Massachusetts Gesellschaft für Förderung der Landwirtschaft durch Dr. H. C. Ernst und den Verfasser; Dr. Ernst's Bericht an die Gesellschaft und die Aktion der Gesellschaft, die Aufmerksamkeit der Staats-Legislatur auf diese Angelegenheit im Jahre 1891 zu lenken; Anerkennung der Tuberkulose unter den Tieren als eine ansteckende Krankheit durch die Gesetzgebung des Staates Massachusetts im Jahre 1892, und eine Geschichte der Arbeit der Rinderkommission und ihres Nachfolgers, des Rinder-Bureau, in den Bestrebungen für ihre Verminderung und Kontrolle von 1892 bis zur Gegenwart.

THE USE OF TUBERCULIN IN CONTROLLING TUBERCULOSIS IN HERDS.

By C. J. Marshall, V.M.D.,
Philadelphia.

There is an increasing desire on the part of breeders and dairymen to get and to maintain herds free from tuberculosis. Consumers, physicians, and veterinarians are also interested in this subject. By good luck or good management many herds have never been infected with tuberculosis. Even more care and better judgment may have been exercised in guarding herds that have become infected.

Tuberculosis may be detected in the advanced stages by a physical examination. The physical diagnosis depends upon the stage to which the disease has progressed, its location, and the cleverness of the observer. No pathognomonic symptoms are known by which the disease can be diagnosed in its incipiency, and there is no case recorded of a herd that has been infected with the disease and made free from it where the diagnosis has depended on a physical examination alone.

Ability to recognize the physical symptoms is an absolutely necessary qualification of the veterinarian, but by this means alone we have never been able to detect all cases and we may never hope to do so. In tuberculin we have an agent that will show the disease in all cases to within a very small percentage. Tuberculin has been used and its action has been critically studied for the past eighteen years. We have yet to find one case where tuberculin has injured or has produced any ill effects in a healthy animal, when properly used. There is no doubt, in the minds of those who have studied it most critically and used it most extensively, of its reliability and harmlessness. It has been criticized for its abuse, not its use.

Tuberculin is but one link in the chain that is used to eliminate tuberculosis from a herd. When its judicious use is combined with the necessary isolation of reacting animals, thorough disinfection, ventilation, and proper sanitation, its value cannot be gainsaid. We have a very large number of examples to show what it will do in controlling tuberculosis when accompanied by other measures for its suppression.

Seeing is believing with many people, and many cannot understand that a disease exists till they can see its external effects or experience losses from

it. Unfortunately, in the case of this disease, much of the damage has been done before there is ocular evidence of its presence.

The true cause of tuberculosis of cattle is no more a mystery; its presence can be detected at an early stage. Its contagious nature has been established beyond all doubt. The disease can be caused in no other way than by the tubercle bacillus, and outside of the animal body it may retain its vitality and virulence for a long time. Agents for destroying the tubercle bacillus outside of the animal body are well known and can be applied practically. For these reasons the task of eradicating it is not impossible. It is, however, difficult in some cases.

We realize more and more that tuberculin is a safe, reliable test when honestly and intelligently used. There is no doubt but that its use should be restricted to those who are competent and skilled in its use, as well as in the diseases of animals, who possess good judgment and are as truthful as tuberculin is itself. There is no better means for defeating the value of this test than to allow it to become a household remedy. Any intelligent person can soon learn to use a hypodermic needle and a thermometer. There are other things about the tuberculin test that are more complicated, and at times men the most skilled in its use are put to their wits' end to know how to handle peculiar questions that arise in connection with this subject. It would be as easy, and far safer for the community, to try to teach the average farmer to be his own blacksmith, wagon-builder, lawyer, physician, etc., as to instruct him to do his own testing for tuberculosis. We need more persons who are skilled in the use of tuberculin and in the control of diseases of animals in general. The States or governments should spare no effort in training men as thoroughly for this work as the importance of the subject requires.

The time may not be ripe for legislation to attempt the compulsory eradication of tuberculosis from all herds, but many individuals have discovered that the disease can be controlled, and that it is more economical to do this than to let it run its natural course. The State should at least furnish such men the necessary assistance. With our better class of breeders and dairymen this idea is spreading. The demand for meat and milk from tuberculosis-free herds is helping to bring about this desirable condition of affairs. Medical milk commissions require a tuberculin test once yearly, at least. There is no other known means of ascertaining whether a herd is free from tuberculosis.

The transmissibility of the disease from animals to man is an important question, but it is certain that this disease is transmitted from animal to animal, and those interested in dairy cattle cannot afford to allow it to run unchecked in a herd.

It will be a difficult matter to convince the masses of the fully estab-

lished harmlessness and the usefulness of tuberculin so long as some agricultural and daily papers continue to malign its use. It is hoped that these agencies will soon see the facts in their true light and recommend the truthfulness and good qualities of tuberculin rather than continually to condemn it and to herald the mistakes and blunders that are made by those who are incompetent to use it.

Even those most enthusiastic in the campaign against bovine tuberculosis do not recommend the immediate slaughter of all animals that react to the test. No country, perhaps, could afford such extravagance. There is no doubt but that a majority of the animals that fail to pass this test have a monetary value. The sooner public opinion is educated to this fact, and that the products of such animals can be handled in such a way that their safety can be assured, the sooner will ways be devised to use them profitably, and thereby encourage the cutting off of the main sources of infection.

A sufficient amount of knowledge has already been accumulated in reference to this disease to eliminate it from our herds in a few years if all parties concerned were in possession of the already known facts, and could and would make the necessary effort and sacrifice to apply them. The first necessary requisite would be a thorough knowledge of the disease on the part of the owner, and his willingness to accept and follow the known facts in reference to handling it. No person should undertake this task unless he is willing and able to follow every requirement faithfully. Testing the herd once and cleaning the stable of all known sources of infection is a good beginning, but these measures must be followed year after year till the task is completed. This is especially true in herds where cows are constantly being added from the open market.

It has been found by experience that some cows will pass a satisfactory test at the time of purchase and react to a subsequent test in two months or less. This may be due to one of several conditions. First of all, the test may have been made carelessly or dishonestly, the tuberculin may have been inert, or the animal may have been in the incubative stage of the disease at the time of purchase, and therefore fail to react. It is known that there is a period of incubation for tuberculosis of from eight to fifty days. It is also known that animals will not react to a test during this period. Another possible cause for a reaction soon after purchase is the fact that the stable may not have been disinfected before the new members were added to the herd, and thus they may have contracted the disease in their new quarters. Some animals have a much higher resisting power to this disease than others; this is especially noticeable in the new members of a herd.

It has been demonstrated that it is not safe to put newly purchased

cows with the old members of a herd till they have first successfully passed a retest. This can be applied two or three months from the time of the original test, and a double dose of tuberculin should be used. Cows from tuberculous herds or from herds tested by the owners may develop the disease in the future, even though they be removed to a sanitary stable after having passed a satisfactory test. For this reason it is not advisable to purchase cows from herds that are known to be highly tuberculous, even though they pass the test successfully. The lesion of disease may become dormant for a time and the diseased area encapsulated, but later it may break down, when the proper conditions are supplied.

In large dairy herds where cows are being added to take the place of undesirable ones, it is a difficult matter to keep the disease out entirely. It can be kept within bounds, and in a form that will seldom show itself physically. The chances are very great that the herd has tuberculosis where the tuberculin test is used only at the time of purchase.

In cases where many reactions are found at the time of test, a retest should be made within six months. If the percentage of reactions is not more than from two to five, and the sanitary conditions are good, the retest can safely be left for a year. In large herds the test should be made at least once a year, even though it has previously passed with no reactions.

The records show hundreds of cows that have been tested at least once each year, and sometimes twice, for several years, and are still breeding regularly, giving a full and profitable amount of milk, and are in perfect health, so far as can be determined by any known method. It is a question as to whether a cow that reacts once to the test should ever be considered free from tuberculosis, even though it may appear healthy, and later pass the tuberculin test.

Some of the most common errors made with tuberculin are due to carelessness or dishonesty. The test may be applied when the animals are in no condition for it. This is especially true in cows offered for sale by dealers. Such animals may be heavy springers, fatigued and overheated by being driven from ten to twenty miles in the heat of the sun, and then kept in a strange stable with no water or an inadequate amount. The weather may be excessively hot and the stable badly ventilated, or an animal may be of a nervous temperament and become unduly excited. Dealers are often anxious to get the animals through the test early in the day, so that they can be shipped or sold, and for this reason the temperature readings are sometimes not carried on long enough after the injection to show the reaction that might take place. The animal may have been injected with tuberculin before an honest test is applied. It happens occasionally that an animal will not react on successive tests where the intervals are less than two months. The test should never be applied unless the animals are quiet, contented, and undisturbed.

In applying the test it is necessary to establish a normal temperature before making the injection. This can usually be done by two preliminary temperatures. The test may not prove satisfactory if the initial temperature is above 103° F. In cases of a high initial temperature, if the temperature is not above normal the next morning, the animal is usually considered to be free from the disease. Where the temperature is high at the beginning, and remains so, it cannot be decided whether the high temperature is a continuation of the preëxisting fever or is a reaction to tuberculin. It is best, by all means, to start with a normal initial temperature.

A temperature measurement should be taken not later than ten hours after injection; eight hours is preferable, and in cases of retest it should be earlier than eight hours. The last temperature should be taken not earlier than the sixteenth hour, but it must be followed longer if there is any upward tendency and a reaction is not already established.

The point at which a reaction is considered positive is a relative quantity. A temperature that rises gradually from the eighth to the sixteenth hour from 102° to 104° or above, under ordinary conditions, can be considered a positive reaction. In well-marked reactions the temperature may rise to 107° or higher. This is more liable to occur in cases of recent infection or where the disease has not become generalized.

In advanced cases of tuberculosis or where the disease is suspected from a physical examination, a rise of one degree should be interpreted as a reaction. In herds where a large number of reactions have been obtained the line may be drawn more closely on doubtful cases. Animals that show a questionable rise in temperature at the time of test should be isolated and retested in about two months. In this case a larger dose of tuberculin should be used. It may be advisable to use three or four doses at one time.

During the time of testing, the herd should be fed, watered, milked, and stabled as usual. Water can safely be given soon after a temperature has been taken, but it should not be allowed freely just before a temperature measurement. In stables where there is a constant water-supply there is no danger of the animals taking enough to interfere with the temperature. Tests in hot, sultry weather may not be satisfactory. So far as possible, it should be arranged to do the testing in the cooler parts of the season.

Advanced stages of pregnancy seem to make little, if any, difference with the test. Many successful tests have been made during the day of parturition.

The utmost care should be exercised in sterilizing thermometers, needles, syringes, hands, clothing, etc., before and during the time of making a test. Contagious abortion, tuberculosis, and other contagious diseases may be carried from animal to animal or from herd to herd if this precaution is not taken

For those who are in sympathy with the work, the plan for handling tuberculosis is somewhat as follows: In herds where no animals are purchased, or but few, the tuberculin test is applied, the reacting animals are isolated, and the stable disinfected. If a large percentage of the herd fails to pass the test, the above measures should be resorted to again in six months. Where but few reactions are found, the retest can be deferred for one year. It is not safe to allow more than one year to elapse before making the retest, which should be repeated yearly.

In herds where animals are purchased frequently, the test should be applied at the time of purchase by a veterinarian approved by the purchaser. Animals thus tested and passed should be kept on probation for two months and retested before they are allowed to mingle with the older members of the herd. The stable in which these animals pass the period of probation should be carefully disinfected before they are admitted to it. The test of the herd should be applied at least once each year. In cases where many reactions are found, the test should be made every six months until a low percentage is obtained. It is not advisable to test too frequently. The repeated use of tuberculin may produce immunity to the test. Cases that do not react to a retest are exceptional.

The sale or distribution of tuberculin should be controlled by State laws, and it should be given out only on the order of an official veterinarian. Every animal tested should be reported to some officer who has charge of this work, and the records of such tests should be available for public investigation.

Every effort should be made to disseminate what knowledge has already been accumulated in reference to handling tuberculosis. The disease can never be satisfactorily controlled as long as ignorance and old, false ideas reign supreme.

BOVINE TUBERCULOSIS IN MAINE FOR TWENTY YEARS.

By John M. Deering,
Saco, Maine.

Thirty years ago beef breeds of cattle predominated in Maine, but to-day dairy cows are the more numerous. Those old native-born Durham breeds, mixed more or less with the hardy Devon, were strong in lung and limb, and, being raised in open barns, fed in winter upon only hay, summered in the pastures, acclimated to our severe climate and conditions, they were reared and raised under conditions that would build up a strongly constituted animal, and one that would not be susceptible to tuberculosis. At that time tuberculosis among cattle in Maine was practically unknown. About this time conditions changed, and a revolution in the cattle industry began. It was surprising how quickly those dark-red, high-horned beef breeds disappeared and the fawn-colored Jersey took possession of the hillsides of Maine. The farmers not only changed their breeds, but changed the habitations from open barns to closed tie-ups; they changed the feed from home-grown products to concentrated food-stuffs, never realizing the importance of the health of the animal, and not thinking that they were dealing with a more delicate animal, they aimed only for one point—the almighty dollar.

This change was brought about by the farmer buying foreign, pure-blood bulls of the dairy type to build up his herd, and soon pure-blood breeders were to be found all over the State. Even the State College farm was stocked with fine dairy cattle, and the young were sold to farmers at a much lower rate than they could be bought for elsewhere, and the business prospered for a while, neither the breeders nor the farmers realizing that they were on the road to trouble, in the way of tuberculosis.

Prior to the passage of the cattle commission law, in 1889, one of our State institutions had been breeding pure-blood beef stock; but when the dairy interest commenced to awaken, they were among the first to start in breeding Jerseys. Everything was going along splendidly, when, in 1886, the cattle commission was called upon to investigate this herd. Tuberculosis then was very little known in Maine. Some cases had been diagnosed after the death of the animal, and all animals were condemned by a physical examination. The herd proved to be badly tuberculous,

and during March and April of that year, 52 of them were destroyed and shown conclusively to have been affected. There were many and various opinions as to the advisability of the slaughter. An investigation by the legislature was ordered, and many noted scientific men appeared before the investigating committee, giving their views upon the matter, and the subject was well ventilated. All up and down the State men took sides, either for or against, and many bitter animosities were engendered. Fourteen young bulls were known to have been sold from this herd (if not more), and were scattered over the State for breeding purposes, and the great controversy came over the policy of gathering them in and destroying them, for they came from badly infected mothers, as proved by the post-mortem examinations.

They were not looked after, either from lack of funds or lack of public sentiment. The diseased progeny of these bulls can be traced, with no uncertainty, up to the present time. Wherever one was located, there was a center of disease plainly traceable to him. Men may have honestly differed in opinion at that time as to the policy of slaughter, but no investigator at this time can go into the matter without arriving at the conclusion that it was a mistake not to have gathered them all in and destroyed them.

Shortly after the slaughter of the herd a general law was passed, which law remains on the statute-book to-day, and with some amendments constitutes the law under which the present cattle commission is working.

In the year 1894 I became a member of the cattle commission. This was in the early days of the tuberculin test, and it had never been used in Maine. There was a noted herd of pure-blood Guernseys in the State, and the owner called upon the commissioners to examine the herd, as he was suspicious of tuberculosis among them. It was decided to test them with tuberculin, and of the 30 head, 19 reacted. I was present at the slaughter, and some 50 farmers and others were present, to see what could be seen. It was a critical time, and three times during the day the commissioners were upon the point of stopping the work, on account of the post-mortem examinations not showing up the disease sufficiently extensive to justify the then skeptical opinions. However, the work proceeded and the herd was cleaned up. There was a case that did not react, and consequently was not slaughtered, but it afterward proved to be tuberculous, and was quoted against the commissioners for many a day. This locality has always been one of the worst infected districts in the State.

During the year 1896 the Portland Board of Health passed a by-law that all cows supplying milk for the city should be tested with tuberculin. The measure was fought by the producers, and was finally passed upon by one of the judges of the Supreme Court, who declared the by-law legal;

but the opposition was so strong that the Board of Health finally modified the order to a physical examination, instead of the tuberculin test, with the result that but one animal was turned over to the commissioners as diseased out of 5000 claimed to have been examined by them.

During this year, 1896, the city of Lynn, Mass., also passed a similar law of tuberculin test, and the farmers of Maine who were supplying milk to that city, rather than lose their market, submitted to it. Some 250 cows were tested, and 30 were condemned and destroyed by the commissioners. Several other cities succeeded in getting some 2000 cows tested, and 206 cows were condemned.

This unsuspected state of affairs brought the cattle commission into debt $8400, and this amount was referred to the legislature. The result was that the legislature said that the commission had no right to exceed the appropriations, and voted to abolish the board. However, the vote was reconsidered the next day, on the ground that it was unfair legislation to turn down a State department without an investigation. The issue was fought out, and the commission won, the deficiency was paid, and the appropriation raised from $2500 to $5000 per year.

During the following year only 47 cattle were condemned, and the business was practically at a standstill. The Board of Agriculture and 90 per cent. of the farmers were against the tuberculin test, and in the year 1899 the farmers informed the governor that there must be a change in the membership of the Board of Cattle Commissioners. They said the veterinarian must be removed and a farmer put in his place—one known to be opposed to the tuberculin test. The farmers won, and the governor, when asked why he removed a good veterinarian and appointed a layman in his place, replied, "The farmers sent me a thousand letters and a petition a mile long." Every graduated veterinarian in the State, except one, signed a petition indorsing the farmer and against the veterinarian then on the board, with the result that the present commissioner was appointed, with the full knowledge that he was opposed to the policy of tuberculin test and in sympathy with the farmer, who demanded less killing and supervision. Nevertheless this same commissioner is to-day one of the best exponents of the policy of slaughter of diseased animals, whenever and wherever found, and a full believer in the tuberculin test. This simply shows where public sentiment stood in the matter nine years ago. After twelve years of contention, discussion, and strife—that is, from the college herd in 1886 to a lay Board of Cattle Commissioners in 1899—in the legislature and out of it, we arrived at a point where we saw our pure-blood herds dwindling, some of our best breeders going out of the business discouraged, our dairy industry with ruin looking it in the face. In view of these facts the dairymen of Maine took the matter into their own hands,

and for nine years have conducted the business in their own way, and there has not been a complaint, from boards of health or private individual, that has not received attention, in a spirit of fairness to both the producer and the consumer.

Now, what have we done, and how have we done it? By arbitrary methods? No. It has been done along conservative and educational lines. The first step after organizing the new board, June, 1899, was to issue new rules and regulations, open a set of books, and advertise a square deal. By the terms of the general law passed in 1889 any rule or regulation which the cattle commission sees fit to make, provided they can get the governor to indorse it, has the full force and effect of the general law, and under this provision the commission has issued all of the regulations from which we are to-day deriving the greatest benefits.

All cattle brought into Maine from other States must be tested with tuberculin within thirty days of arrival, regardless of any other test made. Cattle condemned under this rule are not paid for; they are at the owner's risk. Cattle that have been in the State three years are paid for upon the basis of health. The limit of appraisals on grade cattle is fixed at $50, and on pure bloods at $100, the owner recovering one-half of the appraised value. All cattle are assigned to the State when the appraisals are made.

By far the most valuable part of the law is an amendment made in 1905, making it unlawful for owners of pure-blood animals to pass ownership of the same without their being tested with tuberculin under the direction of the cattle commission. Under this law it was necessary to send a veterinarian to test pure-bloods every time a change of ownership took place, and the commission, to do away with the continual running which this necessitated, entered into an agreement with the pure-blood breeders to test out the entire herd every year, and during the year to grant certificates of health when demanded by the terms of the law. Under this agreement, during the year 1905, practically all of the pure-blood herds of the State were tested out, and about 20 per cent. of them were found diseased. In 1906, 1907, and 1908 this same testing was done, with the result that the pure-blood herds of Maine are practically free from tuberculosis. The herds tested are fully so, and will be kept so; but some few breeders have not availed themselves of this provision, and their stock does not pass current in the State.

Some herds were entirely wiped out and some badly reduced on the first test. The second test showed, in most cases, a clean bill of health; and the third test, a continuation of the same, so that breeders have taken on new confidence, and business is becoming more and more prosperous every year. This law has been our salvation, as it commenced at the right end, because the pure-blood cattle were responsible for the trouble getting into the grade

herds. This pure-blood testing is done at the expense of the State, as is all other testing where the result is a condemnation. Any person has a right to demand of the commissioner an examination of their stock, with this proviso: that if it turns out not to be diseased, they must pay the bill. If diseased, the State will foot the bill. The expense consists of the veterinarian's bill for testing and his expenses.

One of the first things that the commission undertook to do was to get the coöperation of the Maine Veterinary Medical Association. There had been a veterinarian on the Board of Cattle Commissioners previous to this time, and many jealousies and personal feelings had crept in, having much to do with destroying the usefulness of the Board. We met them at one of their meetings and explained that while the law gave us the power to appoint agents, we did not propose to do so; but that we were to throw the work open to all veterinarians equally, and no favors. If one of them found a case of tuberculosis in his practice, it was his case, and he should be paid for services rendered. This proposition was satisfactory to the members, and has continued so ever since. We said to the farmers and breeders, "Take your choice of the veterinarians when you want any testing done," and, as a rule, they selected the best. This method has so shaped itself that at the present time the best men are doing most of the work, and confidence has been restored between the farmer and the veterinarian, and the old-time prejudice has passed away.

About this time a new Commissioner of Agriculture was appointed, and he being a farmer and dairyman, we were not slow about soliciting his good-will and coöperation. We urged upon him the necessity of carrying along the work in the farmers' institutes, covering hygiene and sanitary conditions, and this has been done in a very satisfactory manner.

When the heads of the different State departments saw that the policy of the commission was working out successfully, they were more than glad to coöperate and assist us in carrying along a line of work in the way of increasing appropriations and strengthening public sentiment, and it is very gratifying to be able to report that we have the coöperation of the Commissioner of Agriculture, the State Board of Health, the State Dairymen's Association, the Creamery Association, and I might say all the departments, and we are all working together in harmony. Coming down to a later date (1906), the Portland Board of Health again enforced the by-law demanding the tuberculin test from every producer of milk and cream for that market. The commissioners coöperated with them as far as the law would allow, and after considerable discussion the test was made upon about 6000 cows, and about 6 per cent. proved to be diseased. The following year (1907) the same herds were tested, and less than 3 per cent. were found diseased. The present year (1908) the test is now being made, but the final result is not obtainable, but we think now that it will fall below 2 per cent.

The testing of the pure-blood herds has been carried along for three years, the first test showing 20 per cent. diseased, the second showing less, and the year 1908 showing less than 5 per cent. Other cities and localities in the State have passed by-laws similar to Portland, and have had their herds tested, and within the last year 20,000 cattle have been tested, and the result is that about 4 per cent. have been condemned.

Do we believe in the tuberculin test? Yes. Is tuberculin infallible? No; neither is anything else made by man. We believe it to be the best agency known to human science to diagnose a case of tuberculosis. Tuberculous cattle are not all sick. We test cattle in Maine to get rid of the diseased ones, for the dairymen do not want them in their herds. They know by actual experience that the longer tuberculosis remains in a herd, the more of it there will be, and that, as a matter of dollars and cents, it is not profitable.

I will speak of only one herd, consisting of 175 head. Eight years before it was destroyed it was tested, and 25 per cent. reacted. In five years it was retested and 75 per cent. reacted. In three years more it was retested and 100 per cent. reacted, and they were all destroyed. This was told to the commissioners at the time of slaughter, and is only a fair illustration of what is going on in other herds where tuberculosis is allowed to remain. The danger of tuberculosis to the cattle industry alone is sufficient to justify the destruction of every tuberculous animal. The most important question now agitating the minds of cattle-owners throughout the country is whether it is profitable and practical to destroy all reacting animals, especially those that do not show physical evidence of the disease. Some States do not destroy unless the physical evidence warrants it, and that policy is causing more or less trouble in the States that do not discriminate.

In Maine we have never discriminated, because with us we have been unable to sell the animal or its product; neither do I believe that the people of any other State or community would willingly buy an animal or its product if the fact of its being tuberculous were known. The only way it can be sold is by secrecy in the matter.

Our law says that the animal must be quarantined or destroyed, and the State, being the highest bidder, gets the animal. An animal that shows physical evidence of tuberculosis is an animal that is dying of the disease. Death and decay are taking place and cannot be stopped. If slaughter is ever to take place, it is high time that it were accomplished, and to my mind it should have been done months before.

At the present time there is but little controversy in Maine about destroying animals that have reacted to the tuberculin test. In practice it has been found that of 100 condemned cattle, there is from 4 per cent. to 5 per cent. that upon our post-mortem examinations will not show evidence of the

disease. Another 10 per cent. to 15 per cent. show only slight evidence of the trouble. The remaining, or 80 per cent., show such conclusive evidence that the most skeptical are satisfied and glad to be rid of the animals. It is with the 5 per cent. of animals that fail to show evidence of the disease on post-mortem examination that the whole fabric of controversy rests. Many farmers knowing little of the theory of the tuberculin test, and practically nothing of tuberculosis in cattle, were apt at first thought to say that a mistake had been made, and in some cases designing persons were more than willing to encourage and foster this belief in their minds.

Ten years ago it was a more common belief than it is to-day. It is now more generally understood that if there is the slightest disease about the animal, it will react under tuberculin. There must be a time when the animal passes from a sound to an unsound condition. Not that it passes directly from a healthy to an utterly diseased one; but just as seed sown in the ground germinates and grows. As daylight passes, who can say just when night begins? The seed of tuberculosis is sown and tuberculin will show it up, whether much or little, and does not need the full-grown plant of luxuriant disease. The germinating seed answers every purpose; but the change may not be distinguishable to the eye; yet who can say (if allowed to know in advance) how soon, or when, this seed can grow to the tree of disease that envelops the whole carcass?

As my work and experience have increased, so has my belief that theory and practice show the truth about tuberculin—that it will demonstrate the presence of tuberculosis, whether much or whether little, with wonderful precision. We used to have some controversy over the cases that only showed slight evidences of the trouble, but we taught the farmers that if they used tuberculin they must submit to its results; that it could not nor would not reveal all cases; but if the animal reacted, it was surely tuberculous, and while a small percentage might show the trouble only slightly, no man could tell what ones they were by the test or the reactions, and that if we undertook to leave any, we were as liable to leave the worst one as any other. Very many animals that have shown physical perfection during life were proved to be badly diseased when destroyed, and I have grown to the belief, more every day, that its physical condition is no evidence of its actual condition.

The cattle commission of the State are in accord in this matter, as their every-day experience is very conclusive on this point. One must believe the evidence of his own senses, and I cannot believe to be true what some one gives as his opinion, when my every-day work shows me the utter fallacy of it. And to my mind physical condition is no guide to go by, and any State, community, or person who takes it for a guide, is following a false light. Neither age nor breed affects the susceptibility of an animal, and I have seen a calf eight weeks old as badly affected as any matured animal.

In eighteen months, through the introduction of a diseased animal (one that did not show the physical evidences of the disease when purchased), a herd of 26 animals that were tested and found sound were infected so that 24 out of 26 were condemned, and all but one plainly showed the disease upon post-mortem examination. This herd was under the very best of hygienic surroundings—all that money could buy or ingenuity could suggest. Very many similar cases I could quote, but if the few will not suffice, the many will not convince.

The question is, Will tuberculosis destroy the cattle industry of the country if allowed to remain in the herds? The experience of the Maine commissioners is that it will, and the records that we keep justify us in no other belief. In herds where tuberculosis was allowed to remain, it swept the whole herd, even when every effort (except the right one) was made to separate the diseased animals and to sterilize the milk for the calves, at an expense of $5000 for a plant, under expert medical guidance, and all for what? A theory, and a poor one for us.

If Maine had followed out the policy of only condemning cattle by a physical examination, she would to-day have a percentage five times greater than she has, and I am glad to say that when the cattle commission report to the next legislature in January, it will be that out of some 25,000 cattle tested with tuberculin, there were only a little over 3½ per cent. found diseased.

The policy of Maine is to get rid of tuberculosis if possible, and we are working by four methods: First, by the tuberculin test. Not because we love it, but because it is the only way at present by which we can clean up a tuberculous herd. Second, by teaching breeders that better sanitary conditions are necessary. Not that good sanitary conditions will cure, but that they will prevent many times. Third, by carrying out a strict system of disinfecting premises where disease has been found, and knowing by experience that simply taking out the diseased animals from a herd does not remove the whole cause, but only so far as that animal is concerned, and we consider it just as important to disinfect the premises as to remove the diseased animal. Fourth, by the use of bovovaccine upon calves. We have now 100 of these young cattle growing up, some coming two years old, and we are watching results carefully in order to demonstrate its value to our cattle industry.

No State will ever be successful in eradicating tuberculosis by a mean cheese-paring policy. In order to be successful, the cattle commissioners must have the coöperation of the owners of the cattle; and in order to get it, we must have a good healthy public sentiment, for without this the work will be a failure. We had no success in Maine until the farmers learned that it was for their interest to clean tuberculosis out of their herds.

We have several large breeders that hold the commissioners responsible for

the keeping of tuberculosis out of their herds, and the pure-blood breeders of the State are in the best and most prosperous condition that they have been in for ten years. The pure-blood law, passed four years ago, has done more in reducing the percentage of disease than all of the work that was done in the ten preceding years, and if the policy is continued (and I feel sure that it will be), at the end of the next five years the cattle industry of Maine will be above and beyond suspicion of tuberculosis.

In conclusion, I wish to say that there are many things that I have left unsaid on account of time; such as proposed new legislation, and the action of the Maine Creamery Association recently taken in regard to having a general test made embracing the whole cattle population of the State. There is a strong sentiment for the latter, and at a recent meeting of the State Board of Health a committee of one from the State Board of Health, State Board of Agriculture, State Dairymen's Association, Maine Creamery Association, Maine Veterinary Medical Association, and Maine Cattle Commission, was appointed to take into consideration what new legislation was necessary, bearing upon public health interests in connection with animal industry.

Within ten years our appropriations have been increased from $2500 to $40,000 per year, and public sentiment has grown from indifference to active coöperation from both private and official sources. We claim no wisdom above others, neither do we criticize the policy of any other State or community in handling tuberculosis, and while we use tuberculin quite freely and adhere strictly to its results, we would hail with joy any other method that would do away with the slaughter of cattle; yet with our small percentage of tuberculosis in Maine, we believe that our policy for us at present, considering our conditions, is working successfully, and that at some future time we shall be able to make a still more favorable report.

THE VALUE OF TUBERCULIN IN THE CONTROL OF TUBERCULOUS HERDS.

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The awakening to the fact that tuberculosis existed to any considerable extent in the cattle of America was a result of the discovery of tuberculin by Robert Koch and its later application as a diagnostic agent. A careful inquiry into the extent and distribution of bovine tuberculosis shows that it is most prevalent in those districts where there has been the greatest interchange of cattle. As its dissemination depends largely upon the introduction of infected individuals, it was not strange that with an unrestricted cattle traffic many infected animals were innocently bought and sold, thereby carrying the disease and spreading its virus. The usual slow development of tuberculous lesions in cattle, and the fact that many infected individuals are spreading the bacilli before their true condition is suspected, made it possible for a large number of herds to become extensively diseased as a result of the increase in cattle traffic caused by the constantly growing demand of our large cities for milk.

When the extent of bovine tuberculosis was first ascertained, there was a tendency to radical State control and slaughter of infected animals, because of its supposed sanitary significance. The disease appeared to be one of such magnitude that the people looked to the State for both counsel and financial assistance in its eradication. The State efforts by legislation and official control, however, have not eliminated it as quickly as was generally anticipated. With a growing knowledge of tuberculosis and its parasitic nature, we are coming to realize more and more that it is not so much a matter of State as it is one for the individual to deal with. Like a noxious plant, its seed must be kept out. While the State and nation have their responsibilities concerning it, the individual cattle-owner must in the last analysis see to it that his herd is protected from infection, which usually comes with the purchase of tuberculous cattle or the feeding of milk from tuberculous cows to calves. It is therefore largely a personal problem, the solution of which is to be found in the methods adopted and followed by the individual owner, protected by proper legislation, and given as much other assistance by the State as the legislature may see fit to confer. The burden of the effort to eliminate bovine tuberculosis is with the individual farmers in whose herds the disease

may exist. The work before us is to formulate methods that will enable individual cattle-owners to apply the present knowledge of tuberculosis to the existing conditions in their herds with the least loss and with the quickest returns. It is my purpose, therefore, to discuss the subject of bovine tuberculosis as an individual matter, and to point out the value of tuberculin in this personal conflict with it.

As tuberculin made it possible to determine the presence of tuberculous infection, it is also the one indispensable agent to rely upon in the control of this parasitism. While many of our States have passed laws relative to the use of tuberculin in the official effort to control tuberculosis, a large number of cattle-owners have privately attempted to eradicate it by the same means. In New York I have collected some data on this point. In 1907 I secured the results of the tests made (1904–06) with tuberculin on 683 herds, containing a total of 12,721 animals. Of these, only 262 herds, including 3088 animals, were tested by the State, while 421 herds with 9633 animals had been thus examined by privately employed veterinarians. The practical dairymen have come to recognize the inefficiency of a physical examination and the necessity for some specific reaction to detect tuberculous infection. This has caused the value of tuberculin to be appreciated and employed by a steadily increasing number of cattle-owners.

In using tuberculin certain apparent discrepancies have appeared, which have caused many dairymen to question its value. This is due to the lack of knowledge concerning it. The dairyman does not distinguish between active, healed, or latent tuberculous lesions, and up to a comparatively recent date pathologists have been unable to instruct them in the significance of these technical differences. It is important, however, that the interpretation of the reaction or non-reaction to tuberculin should be clearly understood. The experience of the last few years has called into question certain interpretations and conclusions concerning its accuracy that heretofore were accepted. The findings of Carini, that failure of tuberculin may be expected in about 17 per cent. of cases, and of Lignières, that a tolerance may be established which results in a failure of the tuberculin to give a reaction in certain cases where later post-mortems reveal the presence of tuberculous lesions, have been somewhat general when tuberculin has been applied under certain conditions. The phenomenon of the tuberculin reaction has not been satisfactorily elucidated. The explanation offered some ten years ago by Eber, and recently modified by Smith, will, if correct, do much to clarify the confusion regarding the non-reaction to tuberculin in cases where there are healing tuberculous lesions. According to this theory, for the action of tuberculin, "the tubercle bacilli have induced certain tissue changes, and with them certain new functions of the tissues have been aroused, which are the result of immunization." It is the action of the specific product result-

ing from these changes upon the tuberculin that causes the latter to split off a poisonous substance which causes the elevation of temperature.

A study of tuberculous lesions shows that when the process of healing begins, there is formed about the foci a wall of fibrous or fibrous and cellular tissue, which tends, to a certain degree, to separate the lesion from the surrounding tissue and the circulation. The specific product resulting from the tissue changes as stimulated by the tubercle bacilli in the focus is therefore largely confined to the diseased area, and cannot act upon the tuberculin if it is subsequently injected. This explains the failure of tuberculin to react in those cases where tubercles are healing. As a small part of the specific product of the tubercle may be disseminated in the circulation or surrounding tissues, and as its elimination may be slow, it is not unlikely that the partial reactions that often occur may be explained on the hypothesis that there still remains enough of the specific substance to liberate poison sufficient to disturb the temperature, but not to cause a characteristic rise. More extended investigations are necessary to determine at what stage in the healing process reaction ceases either in part or completely. It is presumable that a number of conditions contribute to this result. In an experiment with 17 tuberculous cows, 12 failed after a certain time to react. The post-mortem examinations revealed lesions that were small and few in number, and in all cases but one they showed evidence of healing. In four of the five cases that reacted quite as much reactionary tissue existed about the tuberculous foci as there was about those in the animals that failed to react. In one the disease was very active and general. In other words, the line of demarcation between the lesions in animals that react and those that fail to do so is not always apparent. Likewise, the failure of the animals to react during the period of incubation, and the reaction that occurs before lesions are in evidence, bring us to another point that must be recognized and explained on the same basis. Because of these limitations of tuberculin, results have been accepted as failures when the conditions were such that the tuberculin could not cause a reaction, or when the reactions have occurred before the lesions were of sufficient size to be readily found, or were localized in organs and tissues not ordinarily examined.

In the application of tuberculin by veterinarians for eradicating tuberculosis in private herds it is very important that the limitations of its action be fully appreciated and explained to the owners. This is desirable in order that the necessary precautions may be taken and the expectations of the owner so adjusted that he will not be disappointed by the future results. The tendency of cattle-men to believe that when an animal fails to react or ceases to react, if it has previously done so, it is perfectly safe to be placed with sound animals, cannot be overcome without duly acquainting them with the facts. If the limitations of tuberculin and the possibilities of infection are

taken into account, the conservative method of dealing with bovine tuberculosis, as first recommended by Professor Bang, has great possibilities. In the State of New York it has been applied in a number of private herds with excellent results. In certain breeding herds it has been the means of saving valuable strains of animals. After separating those that respond at the first test, repeated injections at proper intervals have pointed out the individuals that were infected, but did not respond in the beginning. The breeding from the infected animals has been successful, so that the infected individuals have been replaced by sound ones. The infected animals are eventually a loss to the owner beyond what beef value they may possess; but valuable strains have been preserved, so that the final depreciation is not serious. There are scores of infected herds in New York State that are being replenished with sound animals after this method, and the Commissioner of Agriculture of that State is recommending it to the dairymen generally.

The real purpose of the Bang method is to build up a sound herd from a tuberculous one. The existing conditions relative to the duration and extent of the infection are important factors in considering the probable outcome of non-reacting animals in the original herd. In certain herds where the Bang method has been applied under my personal observation the results have been quite different respecting the original non-reacting animals. In one case where there were 17 reacting and 13 sound individuals, but one of the 13 subsequently reacted, although tested semi-annually for four years. In other herds a much larger percentage of the supposed sound animals were victims of this insidious infection.

In one herd of 491 animals tested there were 96 cows that did not react. These were placed by themselves in a practically new barn, and three months later, and every six months thereafter, the sound herd was tested. Those that responded were promptly removed and the stable thoroughly disinfected with 5 per cent. carbolic acid after each test. The results of the consecutive tests of the non-reacting animals are exceedingly instructive. They are as follows:

1904.	July	96	tested;	31	reacted,	65	did not	react;	32.2%	reacted.
1905.	Jan.	65	"	8	"	57	" "	"	12.3	"
	July	57	"	15	"	42	" "	"	26.3	"
1906.	Jan.	42	"	15	"	27	" "	"	35.7	"
	July	27	"	3	"	24	" "	"	11.1	"
1907.	Jan.	24	"	2	"	22	" "	"	8.3	"
	July	22	"	1	"	21	" "	"	4.5	"
1908.	Jan.	21	"	1	"	20	" "	"	4.7	"
	Aug.	20	"	1	"	19	" "	"	5.0	"

During this time these animals were kept by themselves. There was no opportunity for infection after they were removed from the general herd. Several of the reactors were examined post mortem. The lesions were slight in extent, but of long standing. They were surrounded by a wall of fibrous

tissue. The conclusion seems to be warranted that these animals were infected while associating with the diseased cattle, and that the lesions had become arrested before the first test was made. The lesions in those examined post mortem were too old and the tests were made too frequently to suspect that they could have started and reached the stage of development found in the short time between tests. The repeated tests of the reacting animals in the same herd support this hypothesis. The tuberculin test, made three months later, showed fully 25 per cent. of non-reactors. Several of these continued not to respond, while others reacted again later. This oscillating of the morbid process between an active and an arrested condition is an important factor in considering the future of the supposed healthy animals and in interpreting the tuberculin reaction.

In addition to the value of tuberculin in eradicating tuberculous infection from a herd it is indispensable in examining cows to be purchased in order to prevent its introduction. If they fail to react, and they come from infected herds, it is very necessary that the test be repeated. Experience has shown that when a herd becomes extensively infected (50 per cent. or more reacting), a considerable number of the non-reactors are suffering from latent or dormant tuberculosis, which may become active later. The failure to recognize this fact has caused the disease to reappear in many herds where the reacting animals from the first test had been destroyed. This is illustrated from the following observation: In July, 1906, 92 cows from a tuberculous district were purchased on the tuberculin test. They were tested every six months thereafter. They were kept by themselves for a year, and were never exposed to known infected cattle after their purchase. The results of the subsequent tests are as follows:

1907.	June	92	tested;	0	reacted.					
	June	92	"	3	"	89	did not	react;	3.3%	reacted.
1908.	Jan.	89	"	24	"	65	" "	"	26.9	"
	Aug.	65	"	4	"	61	" "	"	6.2	"

In 1907 there were purchased for a dairy herd on the tuberculin test 65 cows from a dealer who had secured them from a district in which there is considerable tuberculosis. At the same time 52 cows were bought from a herd that has been kept free from this disease. The results of the subsequent tests of these two groups of cattle which were kept separate and not exposed to other diseased animals are instructive:

(1) COWS FROM INFECTED HERDS.

1908.	Jan.	65	tested;	17	reacted,	48	did not	react;	26.2%	reacted.
	Aug.	48	"	0	"	48	" "	"	0	"

(2) COWS FROM A TUBERCULOSIS-FREE HERD.

1908.	Jan.	52	tested,	0	reacted.
	Aug.	52	"	0	"

These animals were exposed to as much infection—if there was any at all—in barns and pastures as the previously mentioned cases. It is unfortunate that we have not records of these animals extending over a longer period of time, but they are sufficient to point out the importance of considering both the accuracy of tuberculin and its limitations.

Tuberculosis is unlike most other infectious diseases in that the tuberculous animals still retain their beef and breeding values if the disease is detected early. It is this intrinsic value of the slightly infected animal, in some cases exceeding its value as a milk producer, which justifies the opinion set forth in this paper, that for the best and quickest results in eliminating bovine tuberculosis it must be controlled in individual herds. It is in this connection that the subject comes close to the practising veterinarians, who, as guardians of the health of the animals, have not only great responsibilities concerning the prevention of this disease, but also unlimited opportunities.

The work in New York has pointed out very clearly the danger of building up herds with non-reacting individuals taken from herds in which there is a greater or less amount of tuberculosis. The sound herd, rather than non-reacting individuals, should be sought for by the purchaser. This will require more attention to breeding and less indiscriminate buying of cattle. The essential facts that have been elicited from the results of our work, and which we have found to be important in the control of tuberculosis in individual herds, may be summarized as follows:

1. The cattle should be tested with tuberculin, subcutaneous injection, and all of those giving a reaction should be removed. The reacting animals should be either destroyed, slaughtered for beef under proper inspection, or kept for breeding purposes, after the Bang method. The choice of procedure must depend upon existing conditions.

2. The herd should be retested at intervals of from six months to a year, and all reacting animals promptly removed.

3. Cattle for dairy or breeding purposes should be bought from sound herds only.

4. Animals that have once reacted should not be placed with sound cattle, although they may cease to react and remain well to all appearances.

5. Milk from cows of uncertain health should not be fed to calves unless previously sterilized.

6. It is desirable that the owners keep a record of the tuberculin tests of their cattle made by competent veterinarians. Such a record of each animal is a valuable asset.

7. The application of tuberculin should not be trusted to unskilled persons.

8. In eradicating tuberculosis the individual herds are the units to deal with, and their owners must be held responsible for them.

La valeur de la tuberculine dans le contrôle des troupeaux tuberculeux.—(MOORE.)

L'emploi de la tuberculine comme agent diagnostique a rendu possible la découverte de l'éxtendu de la tuberculose bovine en Amérique. Les efforts faits pour exterminer la tuberculose bovine par la législation, n'ont pas eu le succès auquel on s'en attendait généralement. Quoique l'état ait sa responsibilité dans cette question, les propriétaires de bétail ont individuellement le devoir de prendre des mesures pour que leurs troupeaux ne soient pas malades. La charge d'éliminer la tuberculose bovine appartient aux paysans dont les troupeaux sont ou peuvent devenir infectés. La tuberculine est un agent indispensable pour tenir la tuberculose loin des troupeaux sains ou pour l'éliminer des troupeaux infectés. A New York, les efforts pour combattre la maladie, sont pour la plupart individuels. Entre 1904 et 1906, parmi les bêtes chez lesquelles la tuberculine a été employée, il y eut moins d'un tiers qui furent examinés par l'état.

Beaucoup de propriétaires de bétail n'ont pas pu comprendre l'interprétation de la réaction et de la non-réaction de la tuberculine. L'expérience nous dit qu'après une réaction positive on peut trouver des lésions tuberculeuses, actives à l'examen du cadavre. Quand on n'en voit pas, elles existent certainement, mais se trouvent dans des endroits ordinairement inaccessibles, comme les os, ou bien elles sont microscopiques. Si la réaction est négative, l'animal peut être infecté, mais la maladie est dans la période d'incubation, ou elle est arrêtée, ou encore elle est entrée dans la phase de la guérison. La guérison peut être temporaire ou permanente. Le pourcentage de cas où la maladie est arretée temporairement dans une ferme infectée, est qui ne répondent, par conséquent, pas à la tuberculine, semble dépendre de la longueur du temps depuis que l'infection se trouvait dans le troupeau et du nombre de bêtes qui ont des bacilles. Les fermiers devraient comprendre que les bêtes achetées par eux qui n'ont pas réagi à la tuberculine, mais qui proviennent de troupeaux infectés, peuvent montrer plus tard une réaction positive. On explique le défaut de réaction de la tuberculine dans certains, si non dans tous, les cas arrêtés par la théorie d'Eber, modifiée par Smith, et, en second lieu, on explique la non-réaction dans ces cas par la formation d'un tissu fibreux qui entoure la lésion. Dans ces cas, les produits spécifiques sont pour la plupart limités au foyer ou ils peuvent avoir été éliminés, de sorte que la tuberculine ne vient pas en contact avec eux. Si l'on apprécie bien l'action de la tuberculine et les conditions sous lesquelles elle peut manquer de réagir, on sera plus capable de juger des résultats de l'emploi de ce moyen diagnostique et prévoir l'avenir probable des animaux qui ne réagissent pas.

1. Quand un troupeau est très infecté, un grand pourcentage des animaux non-réagissants peuvent avoir la maladie d'une manière latente. Ces animaux peuvent réagir en n'importe quel temps, pendant quelques années.

2. Quand, dans un troupeaux, il y a très-peu de réactions, les bêtes non-réagissantes peuvent plutôt être libres de toute infection.

3. Dans les troupeaux où il n'y a pas de réactions du tout, on est sûr qu'il n'y a pas d'infection tuberculeuse.

4. Un animal qui réagit et cesse de réagir plus tard, ne doit pas entrer dans un troupeau sain.

5. Les marchands laitiers ne doivent acheter que des vaches provenant de troupeaux sains.

6. L'élimination de la tuberculose bovine dépend des efforts individuels du propriètaire de bétail.

7. La tuberculine ne doit pas être employée par des gens qui ne s'y connaissent pas.

8. La grande aide que nous offre la tuberculine est sa puissance de provoquer une réaction dans une infection active très légère. Ceci donne au propriétaire la possibilité de sauver à temps la valeur de l'animal, comme bête à engendrer des petits ou comme viande.

Der Wert des Tuberkulins in der Kontrolle tuberkulöser Herden.—(MOORE.)

Die Aufdeckung der Ausdehnung und weiten Verbreitung der Rindertuberkulose in Amerika war möglich durch die Anwendung des Tuberkulins als ein diagnostisches Hilfsmittel. Während der Staat seine Verantwortlichkeit zu tragen hat, müssen die einzelnen Rinderherdenbesitzer Massnahmen treffen, um ihre Herden frei zu erhalten. Die Bürde der Anstrengungen, Rindertuberkulose aus der Welt zu schaffen, lastet auf dem Farmer, dessen Herden infiziert sind oder es werden können. Um Tuberkulose von gesunden Herden fernzuhalten oder von infizierten hinweg zu schaffen, ist Tuberkulin ein unentbehrliches Hilfsmittel. In New York sind die Bemühungen, diese Krankheit auszurotten, grösstenteils individuell. Während der Zeit von 1904 bis 1906 probierte der Staat weniger als ein Drittel der Tiere aus, die mit Tuberkulin untersucht worden waren. Die Unterscheidung der Reaktion oder Nicht-Reaktion auf Tuberkulin ist manchem Herdenbesitzer schwer verständlich zu machen. Unsere Erfahrung ist, dass man nach einer positiven Reaktion aktive tuberkulöse Verletzungen bei der Autopsie entdecken kann. Wenn berichtet wird, dass sie nicht gefunden wurden, existieren sie dennoch zweifellos, doch können sie in für gewöhnlich unzugänglichen Teilen, wie den Knochen, vorhanden oder sie können mikroskopisch klein sein. In Fällen, in denen keine Reaktion eintritt, können

die Tiere infiziert sein, aber die Krankheit ist in der Incubationsperiode oder mag zum Stillstand gebracht und in einem Heilungsstadium sein. Die Heilung kann temporär oder permanent sein. Der Procentsatz von Fällen, in welchen die Krankheit temporär in einer Meierei zum Stillstand gebracht wurde, die infiziert ist, und die nicht auf Tuberkulin antworten wollen, scheint von der Länge der Zeit, während welcher die Infektion in der Herde gewesen, und der Anzahl der den Tuberkelbazillus tragenden Rinder abzuhängen. Es ist wichtig, dass die Herdenbesitzer die Möglichkeiten einer zukünftigen Reaktion verstehen, wenn sie Vieh von infizierten Herden auf den Tuberkulinversuch hin kaufen. Die Erklärung des Versagens des Tuberkulins, in gewissen, wenn nicht allen zum Stillstand gebrachten Fällen zu reagieren, ist in Ebers Theorie, wie sie von Smith modifiziert wurde, gefunden für die Wirkung des Tuberkulins und im Heilungsprozess in zum Stillstand gebrachten Fällen, wo die Verletzungen von einer fibrösen Wand umgeben sind. In solchen Fällen ist das spezifische Produkt grösstenteils auf den Herd beschränkt, und irgend etwas, das in den umgebenden Geweben oder der Cirkulation existiert haben mag, kann eliminiert worden sein, so dass das Tuberkulin damit nicht in Kontakt kommt. In einer Würdigung der Wirkung des Tuberkulins und der Bedingungen, unter welchen es versagen mag, zu reagieren, wird man in Stand gesetzt, genauer über die Resultate eines Versuches zu urteilen, und von den gegebenen Verhältnissen sich ein Bild von der möglichen Zukunft jener Tiere zu machen, die nicht darauf antworten.

1. Wenn eine Herde in ausgedehnter Weise infiziert ist, kann ein beträchtlicher Prozentsatz nicht-reagierender Tiere die Krankheit in einem latenten oder schlummernden Stadium haben. Diese Tiere mögen zu irgend einer Zeit während einer Periode von mehreren Jahren reagieren.

2. Wenn in einer Herde wenige Reaktionen sind, so werden jene, die nicht reagieren, eher im Stande sein, frei von einer Infektion zu sein.

3. Wenn keine Reaktionen vorhanden sind, kann das negative Resultat als eine Indikation angesehen werden, dass tuberkulöse Infektion nicht existiert.

4. Ein Tier, welches reagiert, und später aufhört es zu tun, sollte nicht zu einer gesunden Herde zurückgebracht werden.

5. Viehzüchter sollten Kühe nur von gesunden Herden kaufen.

6. Die Eliminierung der Rindertuberkulose hängt von den individuellen Anstrengungen der Viehbesitzer ab.

7. Tuberkulin sollte nicht durch ungeschützte Personen angewendet werden.

8. Der grosse Wert der Tuberkulinversuche ist deren Fähigkeit, eine Reaktion in Gestalt einer sehr leichten aktiven Infektion herbeizuführen. Dies setzt den Eigentümer in Stand, den Fleisch- oder Zuchtwert eines Tieres zu retten.

THE PROBLEM OF BOVINE TUBERCULOSIS CONTROL.

By Dr. M. H. Reynolds,
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A brief review of its historical development may perhaps prove helpful in a careful study of this great problem.

Historical.—At the beginning in each State there has been either an amateurish and premature attempt at eradication, with unsatisfactory and harmful results, or else there has been irregular testing of herds here and there, just because owners wished to know whether their herds were sound, or because they wished to really try the tuberculin test. Such work has been fragmentary and has accomplished little of permanent value.

After a considerable period of this kind of work there has come better organization of individual State work, and there have followed city inspection ordinances providing for tuberculin test of dairy herds.

Following the adoption of such ordinances and the first attempts to put them in force, there has been quite uniformly a prolonged period of frantic opposition by dairymen and fearful anticipation of dire results that were sure to befall the dairy interests and the public milk-supply. Most of these ordinances have led a precarious sort of existence, with many ups and downs, suffering adverse court decisions and many amendments and revisions. But in the mean time the public has been gradually awakening to the fact that there were such things as clean dairies and dirty dairies, and that tuberculosis of cattle was not altogether a myth, but possibly a matter of serious concern. Eventually the dairymen have uniformly fallen into line, conceding the need for this work. The intelligent consumer is by this time asking his dairyman when he had his cows tested and whether be is quite sure that they were all tested.

The miscellaneous scattered work has been gradually increasing over the State, but a careful estimate will always show that but a very small percentage of the entire cattle in any large neighborhood have been tested. Purchasers of breeding cattle soon begin to inquire whether the prospective purchase has been tested or whether the owner will sell subject to test. A few herds are advertised guaranteeing freedom from tuberculosis. Municipal public opinion is by this time generally supporting the idea of city work, and public opinion in general is calling rather blindly for something

more general and more effective, something on a larger scale, but with a very vague idea of what that something may be.

State dairy associations and live-stock breeders associations soon begin to pass resolutions calling for the testing of breeding cattle. And the principle of reimbursement is quite firmly established.

Up to this point—and this is where we are at present in the few States which are most advanced with bovine tuberculosis—the work has not usually been conducted on any comprehensive or well-organized plan that can possibly lead to eradication or to a positive control. Herds that have been tested have not been wisely retested, if at all. Stables in which testing was done have been poorly disinfected, if, indeed, thorough disinfection has been attempted. Stables from which tuberculous cattle have been removed have often been refilled with untested cattle.

I believe that Minnesota has done as much effective work as any other State in the Union, but our work is open to this same criticism of lacking permanence and of incompleteness. We are using a large quantity of tuberculin—and testing a large number of cattle in comparison with other States. Several other States are doing a considerable amount of tuberculin work, but, as the small boy expresses it, we are not getting anywhere. There is no finality about it. We are not getting to the end of the road.

Public sentiment in Minnesota, and perhaps in Wisconsin, Pennsylvania, and other States, is nearly or quite ready for some important development. There is no very clear idea as to what that development may be, for there are two things lacking: first, a comprehensive plan that has in it the possibility of an actual working out; and, second, provision for financial support.

We have passed through a long period of preliminary training for the public and for those in charge of the work, and several States are nearly ready for something different and better. The question is what that something may be. Before taking up this question as a problem to be solved, let us see what individual States are already doing.

A Study of Individual States.

From the list of States that have been doing serious work with bovine tuberculosis I have selected Minnesota, Pennsylvania, Wisconsin, and Massachusetts, because these are pioneers. Their present laws and methods are outgrowths of years of experience. A study of these four will bring out all the important features and methods used in the United States.

The statements made under this heading are based upon the most recent and reliable authority which the author was able to secure. It may be that some States whose work is here discussed may have changed their procedure by the enactment of new legislation or otherwise, and hence possible errors in the present discussion are apparently unavoidable.

WISCONSIN.

The Sanitary Machine.—Wisconsin has placed her veterinary sanitary work with a live-stock sanitary board consisting of three members of the State Board of Agriculture, the experiment station bacteriologist, and the State veterinarian. The State veterinarian is appointed by the governor.

Board members serve without salary, but are paid three dollars a day and expenses when in service. To this board is given the duty of protecting the health of domestic animals, especially against the serious infectious diseases. It has the usual authority to quarantine, kill, make regulations, and so forth.

This State has been making a special feature of public demonstration and educational work. Such demonstrations are frequently held at the agricultural college and at farmers' gatherings over the State. The Wisconsin station has also published a number of valuable bulletins on the subject of bovine tuberculosis.

Distribution of Tuberculin.—An interesting feature of the Wisconsin work, and one which the writer has been watching with some curiosity, has been the general distribution of bureau tuberculin to parties making application. The Wisconsin experiment station in connection with the sanitary board furnishes tuberculin freely and gives instructions for testing to their agricultural students, short-course students, and others, and these are encouraged to do general testing.

Satisfactory information has not been obtained concerning the practical working of this method; but it seems quite certain that a State can hardly continue long to pay, directly or indirectly, indemnity to owners on tests so made, even though the records may be reviewed by the State veterinarian's office.

An official statement published in 1908 gives figures for total tuberculin work. This report shows for the year 1905–06, 9718 cattle tested, 17.7 per cent. reacting; and for 1906–07, 15,816 cattle tested, 8.1 per cent. reactions. During the year 1907–08, 40,993 cattle were tested, with 5.6 per cent. reactions—a total of 66,527, with 8 per cent. of reactions. The total number of cattle tested in Wisconsin by veterinarians for the State during the year 1907–08 is 13,791. As there was a total of nearly 41,000 cattle tested in Wisconsin during the year, there must have been about 27,000 unofficial tests by others using bureau tuberculin furnished by the experiment station. It is thus seen that approximately two-thirds of the testing done in Wisconsin during the past year has been done by farmers, short-course students, dairy-course students at the agricultural college, and farmers in general.

Tuberculous Cattle.—The owner of condemned cattle is granted an option (1) of retaining animals under quarantine, or (2) he may ship them to an

abattoir for slaughter under Federal inspection. In case he chooses the latter procedure, the owner receives the returns from carcass sale and has no further claim against the State. (3) If the owner does not choose either of these methods and the board deems it expedient to slaughter, the owner receives written notice. After a certain procedure, appraisal is had. The amount of appraisal is based upon the value of cattle in conditions as found, the limit being $50. The board may then order such diseased animals shipped for killing to some point where Federal inspection may be had.

It is ordered that the owner shall receive no compensation until the board is satisfied with the disinfection given the infected premises.

Wisconsin pays two-thirds of the appraisal, the amount to be expended not being limited. Assuming that the $60,000 officially reported as paid for condemned cattle during 1907–08 was for the total 2334 reactions, we have a showing of $25.70 per head paid owners, or $25,700 per thousand cattle for reimbursement. The State receives for carcasses $7250 per thousand. Net reimbursement in Wisconsin was therefore $18,450 per thousand.

A statement of the expense of office management in the experiment station's part of this work indicates a cost of $103.75 per thousand cattle tested.

Results.—The census for 1900 gives the total cattle for Wisconsin as 2,314,000. From the best official information, Minnesota cattle have increased approximately 60 per cent. during the same interval, so that 40 per cent. is probably a conservative estimate for Wisconsin. On this basis the present cattle of Wisconsin would number about 3,240,000.

For a study of the amount of eradication work being done by any of the States that are leading in this work, suppose we take Wisconsin, with her 3,240,000 cattle—not as a criticism, nor even as a special study of Wisconsin, but as a general study. Nor does this study of Wisconsin work, or that of the other States here especially considered, take into consideration the splendid and absolutely necessary work in these and other States in the way of educating and arousing public sentiment. At the rate of testing done this year, including the unofficial tests (two-thirds of the total), we have about 41,000, the highest record for one year. By process of simple division we find that about eighty years would be required to test once all the cattle in the State, and one test accomplishes very little toward eradication.

Supposing that the plan of complete eradication is not undertaken, and Wisconsin should attempt to test only her breeding herds and her dairy cattle. A Wisconsin official connected with this work estimates that there are at last 1,200,000 dairy cows in the State to-day. It would be foolish to test only the cows in any stable, so that it will be quite safe to bring the dairy herds up to 1,400,000. This, plus 64,800 pure-breds,

gives us 1,464,800 cattle to be tested, including only the classes of cattle that are the worst and most immediate sources of dissemination. Testing 41,000 per year would require thirty-five years to test once these most serious sources of immediate danger.

I wish to repeat here and very clearly that these statements are not made in an unkind spirit or to belittle the work. Wisconsin deserves generous recognition as one of the pioneers in this field, and for a large amount of work done as compared with the majority of other States.

MASSACHUSETTS.

Sanitary Machine.—In this State authority for dealing with infectious disease of domestic animals is vested in a cattle bureau consisting of one individual—the chief. This bureau works in close connection with local boards of health through inspectors appointed by the local boards and approved by the chief. The Massachusetts law places the first responsibility for examinations, which are physical, upon these local inspectors. These inspectors are not trained veterinarians, but laymen.

Work and Method.—Tuberculin test work is divided into three classes:

(*a*) Examining cattle quarantined by local inspectors or reported by owners as suspected. These cattle are examined by proper agents, who destroy or advise release of quarantine.

(*b*) Quarantine work and tuberculin testing with imported cattle.

During the year ending November 30, 1907, there was done under division "*a*" the following work:

There were quarantined 2985 cattle. Of these, 723 were released; 1478 were condemned, killed, and paid for. Number condemned, killed, and in process of settlement, or otherwise disposed of, 401. Of this item, there were 10 killed, with no post-mortem lesions found.

Work under class "*b*" for this same year shows that the cattle imported at Brighton numbered 84,677. Of these, there were tested 14,480, the remainder being presumably cattle belonging to classes not subject to importation test. Of the tested, 169 were condemned and 49 others were killed on permit. There were released 14,262. In addition to these records for Brighton, official report shows that there were 7238 additional cattle brought in for dairy and breeding purposes, of which about one-third were tested before shipment and the remainder after arrival.

Massachusetts is doing a very large amount of herd inspection, the tuberculin test not being commonly used on Massachusetts cattle. The eighth semi-annual report, January, 1906, gives the total for the year of 32,760 herds inspected; total animals inspected, 230,140, including 143,300 milk-cows. I did not find a statement as to the number of animals so condemned; but very low pay is given these lay inspectors,—in some of the smaller towns,

$15 to $20 per year,—hence it is hardly conceivable that these inspectors are doing efficient work, even in the way of physical examination.

Tuberculin test is imposed for imported dairy and breeding cattle. Beef cattle for slaughter, calves under six months of age, and export cattle are exempt from test. Some testing is done for owners upon applications.

Expenditures.—The following items are given in round numbers and for the year ending November, 1906. The total available for all veterinary control work was $95,854. In this there is included $18,854, balance of a special appropriation for deficiency in 1905 accounts, and appropriations for 1907 work, $77,000. Of this total there was expended $89,337. There were unpaid balances and accounts at the end of the year sufficient to leave a deficit of nearly $3500. These funds were expended in part as follows: (1) Total salaries, $20,232, excluding special agents and expenses for glanders work; (2) employees' expenses, $9896; (3) paid for condemned cattle, $42,326.

Some portion, probably small, of items 1 and 2 should evidently be charged to glanders and other live-stock sanitary board work. The office expenses, including salaries of chief, clerks and assistants, and miscellaneous office expense, amount to $6960.

The officer in charge has estimated for the year ending 1908 for $77,000 to cover all veterinary control work; $7000 of this is for office salaries and expenses and $70,000 for general outside work. The maximum allowance for tuberculous cattle is $40; average for several years is something less than $21.

Results.—The chief's personal estimate of results is to the effect that inasmuch as Massachusetts is killing a few more on physical examination each year, there is probably being accomplished but little in the way of decreasing prevalence; and that they are simply killing cattle that are of special menace to human health.

PENNSYLVANIA.

Organization.—Pennsylvania has a State live-stock sanitary board consisting of the governor, secretary of agriculture, dairy and food commissioner, and State veterinarian. The State veterinarian is ex officio a member and presumably executive officer of the sanitary board, and at the same time reports as State veterinarian to the secretary of agriculture, which makes this organization somewhat confusing to an outsider.

Apparently the arrangement is to the effect that control work with infectious diseases which involve the community as a whole, and dealings with owners of such diseased stock and with owners whose stock is not yet affected, are under the sanitary board; while subjects relating to the health of animals and sanitary work in general, aside from work with infectious

diseases, fall upon the State veterinarian as an officer in the department of agriculture rather than upon the sanitary board. The State veterinarian apparently acts in dual capacity as executive officer for the sanitary board and as State veterinarian in the department of agriculture.

Method.—Dairy and breeding cattle are imported subject to tuberculin test at the expense of the owner.

The Pennsylvania work with tuberculosis is apparently based to a considerable extent upon the theory that owners realize the seriousness of the question, and that they will gladly coöperate if fairly treated, desiring to eradicate.

If an owner wishes to have cattle tested, he makes application to the sanitary board. In order to secure this assistance, he must agree to aid in the examination; to quarantine reacting animals promptly; to disinfect stables; and to improve the stable sanitation if directed to do so.

Application for test from owners whose cattle are not known to be affected may be granted with the owner paying the expenses of test. Official reports are to the effect that so many applications are received that they cannot all be granted with present available funds. An attempt is therefore made to confine the work to the worst infected herds.

When cattle are tested under application from the owner, he must agree to retest at his own expense within eight months, provided one-fourth of the original herd is found to be tuberculous. He also agrees that he will not add untested cattle to his herd thereafter.

An interesting feature of the Pennsylvania work is that when cattle are killed for beef and incidentally found tuberculous to an extent which condemns the carcass for food purposes, the carcass may then be appraised and paid for by the State at a price not exceeding $25 for the entire carcass.

When an owner has cattle inspected by a veterinarian at his own expense and finds some animals diseased, he may apply to the State for assistance in disposing of the cattle that are tuberculous, and receives practically the same help in practically the same way as though cattle were tested at State expense.

When Pennsylvania cattle have reacted in the course of State work as already outlined, they may be disposed of in different ways: (1) Such cattle may be first appraised and then killed. Appraisal considers actual value and condition of the animals, the limits being $25 for grades and $50 for registered cattle. Owners receive the full amount of appraisal, which, however, must not exceed three-fourths of the actual value at time of slaughter. The owner receives the carcass salvage in addition to such appraisal, and the cattle are killed under inspection. (2) Reacting non-clinical cattle may be retained under certain restrictions, presumably for use according to the Bang system. It is stated that owners rarely use this permission.

An interesting provision is made for coöperation between the sanitary board and municipal authorities. When a municipality arranges for tuberculin test of herds supplying city trade, the State board is permitted to bear one-half the cost of such work in case of herds kept beyond jurisdiction limits of the local board of health.

Amount of Tuberculin Work Done.—Pennsylvania uses tuberculin made in her own sanitary board laboratory. During the year 1905 there were distributed about 20,230 c.c. of tuberculin. The laboratory sent out 19,880 c.c. of tuberculin in 1906. We will estimate that this was all used, which would be a very generous estimate for Minnesota. The dose of this varies from 0.25 to 0.4 c.c. Estimating an average dose at 0.33 c.c., there were probably about 60,000 cattle actually tested. The writer was unable to find an accurate statement on this point in the official reports.

For this fiscal year 1905 the board had available a total of $45,000 for general control work. Of this amount, there was expended for reimbursing owners and inspecting cattle for tuberculosis about $29,500. For the year 1906, with the same total appropriation available for control work, the State spent $27,230 for reimbursement and inspection work in connection with this disease. For the year 1904 the sanitary board had available for work $45,000, of which there was spent $31,766 for reimbursement of owners and expense of inspections. During the year 1905 there were condemned 1352 cattle from 773 herds inspected. During the year 1906 there were condemned 1536 cattle from 858 herds inspected.

Please bear in mind that we are not now studying results accomplished in the way of public education and enlistment of public support. These studies of methods and results in the four States selected are presented that we may have a clear view of the amount of field work done with cattle and stables. A further purpose is to show the need for comprehensive plans and large appropriations, and cold figures are more reliable than rhetoric as guides for judgment.

The census of 1900 gives a total of 2,000,000 cattle, of which there are 1,062,000 dairy cows over two years of age, and an estimated 40,000 pure-bred cattle, or a total of 1,102,000.

We have estimated the total number of Pennsylvania cattle tested during 1906 at 60,000. Tests of recently imported cattle should not be included in this estimate. This number tested, when compared with the total number of cattle in the State,—about 2,000,000,—indicates that thirty-three years would be required at this rate for testing all cattle in the State; or, on a basis of 1,022,000 dairy cows and an estimated 40,000 pure-bred cattle, or a total of 1,062,000 dairy and pure-bred cattle to be tested, there would be required for the classes at this rate of testing seventeen years for one test of each herd. One test, even though followed by disinfection, accomplishes

comparatively little in the way of eradication. It will therefore be seen that Pennsylvania, one of the leaders in this work in the United States, is, like other States, really accomplishing very little in the way of eradication or actual control.

MINNESOTA.

The Machine.—Sanitary control work in Minnesota is in charge of a livestock sanitary board consisting of five members appointed by the governor. Three members must be financially interested in the maintenance of livestock, and two members must be veterinarians, graduates of recognized colleges. The secretary and executive officer, as well as field veterinarians and other assistants, are employed by the board without any political oversight. It is provided by law that the secretary must be a graduate from a reputable veterinary college. One board membership becomes vacant each year. Board members receive no compensation except actual traveling expenses.

This board meets quarterly for consideration of work accomplished, to plan future work, and consider proposed regulations. The secretary is an executive officer carrying out plans of the board and provisions of the law. The legal basis for this work and powers bestowed upon this board are very broad, so that the board should rarely or never be hampered by lack of authority to do a given work. Apparently the only probable source of failure in a board so organized must lie in sheer incompetence of board members. Thus far there has been described only the central control power of a great machine, for with this State board there are intimately associated by law 2500 local boards of health and health officers, who have certain prescribed responsibilities in connection with this State work and who are subservient to the State board.

Features of the Law.—It is the legal duty, under penalty, for any one who knows of or suspects existence of any infectious disease to report this to his local health officer, and he within twenty-four hours to the State board. In case of animals to be killed, the owner is given all reasonable protection in the way of protest, appraisal, reimbursement, etc., but the protest does not delay killing.

For veterinary control work Minnesota uses and we much prefer the plan of employing field veterinarians on full time and for the exclusive service of the board. This plan is chosen rather than that of deputy or local State veterinarians, who are engaged in private practice and frequently embarrassed in performance of State duty by reason of private practice jeopardized, and by lack of special training and large field experience. There are many reasons which the writer believes to be good which may be advanced in support of this plan.

Minnesota forbids importation of cattle for dairy or breeding purposes except under tuberculin test. The penalty for violation of this is quite severe, being not less than $500 nor more than $1000, or imprisonment for not more than one year.

Minnesota has had for years a law which provides for the pasteurization of creamery skimmed milk. Such milk has proved a very serious source of dissemination for other States that have no such legislation.

Disinfection and Refilling.—It is expressly ordered by regulations that when cattle are tested and diseased animals are removed and paid for, the owner must disinfect the stables in a prescribed manner and must not put any untested cattle into such stables. Violation of this regulation forfeits claim for future reimbursement.

Method with Tuberculosis.—The general plan with tuberculosis is as follows:

Testing may be done by certain veterinary representatives of a State or local boards or by any graduate veterinarian recognized by the State board for this work. When reacting cattle are found, such cattle are appraised on the owner's premises. They are then shipped to some convenient point within the State where there is Federal inspection, and are there killed under such inspection. If no tuberculosis is found, the owner receives full appraisal, which must not exceed $75 for registered cattle or $35 for grades. Carcasses are disposed of to the best possible advantage, and the carcass returns or salvage goes directly to the owner, who is paid in addition by the State three-fourths of the difference between appraisal and carcass salvage.

A large amount of tuberculin test work has been done in Minnesota and a large number of tuberculous cattle have been disposed of—large numbers when we consider them in the abstract or compare with other States, but very small, as will be shown later, in proportion to the total amount of work to be done. The actual amount of work done, together with a study of the results, expenses, returns, etc., is presented in the following statement:

Tuberculin Work for the Year Ending August 1, 1908.—*Registered cattle* tested, 1329; number of reactions, 490, or 36.8 per cent.

Number of reacting animals killed, 428; number of carcasses passed, 199, or 47 per cent.; number of carcasses condemned, 229, or 53 per cent.

Appraised value of 428 cattle, $27,770.50; average, about $64.

Carcass returns, $5296; average, $13.37.

Owners received from the State in addition to carcass returns, $16,795; average, $39.20 per head.

For all registered cattle appraised in addition to this the State spent for freight and yardage, $666.

The total net cost to the State for reimbursement, freight, yardage, etc., was $17,460; or average for all killed, $40.80.

Grade cattle, number tested, 25,887; number reacted, 2000, or 7.7 per cent.; number killed, 1941; of these, there were inspected, 1797; carcasses passed, 851, or about 47.3 per cent. of carcasses inspected; carcasses condemned, 946—about 52.7 per cent. of carcasses inspected.

Killed without appraisal, 144.

Killed with no lesions found on inspection, 52 animals—about 2.7 per cent. of killed.

Total appraisals, $51,027; average, $26.23.

Total carcasses returns, $17,054; average carcass salvage, $8.79.

Paid owners in addition to carcass returns, including full appraisal for the 52 animals, about $25,820.

Freight and yardage, $1,784.85.

The total expense to the State for reimbursement, freight, and yardage for grade cattle was $27,605, averaging for all grades killed, $14.20. Note that this total cost to the State is the merest trifle over $1.00 per head for all grade cattle tested.

The average percentage of reactions for animals tested regardless of breed was 9.3.

Dr. Melvin has recently reported records of 400,000 tests made during the past fifteen years in various portions of the United States and by various authorities. This shows 9.25 per cent. reactions, the average for all breeds and conditions represented. Note two points: (1) the close agreement with the Minnesota average for the past year, 9.3 per cent. for all classes; (2) that only 400,000 recognized tests seem to have accumulated in the past fifteen years in the United States. Minnesota alone has about 3,000,000 cattle.

It is estimated that 41 per cent. of each of the office salaries and expense, field veterinarian salaries, laboratory expense, and 30 per cent. of total traveling expenses may be charged to tuberculosis work under the present Minnesota plan.

Study of Minnesota work shows the following summarized data for the cost of such work:

Cost of office work per thousand tested, $70.20.

Total cost to the State for tuberculosis work per thousand registered cattle tested—reimbursements, freight, and yardage, $13,137.

Net cost to the State per thousand grades tested for reimbursement, freight, and yardage, $1067.

Appraisal per thousand registered cattle, $63,940.

Appraisal per thousand grade cattle, $26,230.

Carcass salvage per thousand registered cattle, $13,370.

Carcass salvage per thousand grade cattle, $8790.

Net cost to the State for reimbursement per thousand registered cattle tested, paying three-fourths of the difference between appraisal and carcass salvage, $12,637.

Net cost to the State for reimbursement per thousand grade cattle tested, paying three-fourths of the difference between appraisal and carcass salvage, $997. Note the relatively great expensiveness of this work with registered cattle.

Financial Statement.—Minnesota during the present biennium has available $130,000 exclusively for work with tuberculosis and glanders. As before stated, it is estimated that 41 per cent. of the total office and field veterinarian's salaries may be charged to tuberculosis and 30 per cent. of the total traveling expenses. The sums paid in reimbursement for tuberculous cattle during the past year have already been given.

Results and Present Situation.—It is stated on good authority that there is not an untested herd of pure-bred dairy cattle in the State. A considerable proportion of the other breeding herds are reported as tested one or more times. We have twelve cities with tuberculin test ordinances in effect or which will very soon be in operation.

Our cattle-breeders are becoming very cautious about buying untested cattle. The State Dairy Association at several annual meetings during the last few years has indorsed the tuberculin test without a dissenting voice, and called upon the legislature for legal provision whereby stock sold for breeding purposes must be sold with tuberculin test or subject to test.

Of the special features of Minnesota's law and methods there may be summarized the following:

There is a peculiar organization of the sanitary board, previously described. There is a fairly comfortable financial situation, with $130,000 for the last biennium exclusively for glanders and tuberculosis; $172,000 for all work for the board.

There is a close organization of local health officers and township supervisors with the central board. There is concentration of energies and funds on dairy and creamery herds and pure-bred cattle—the most serious factors in disseminating the disease among other cattle and most threatening to people.

A hasty survey of the figures for work in Minnesota, as in other of the few States that are doing considerable work with tuberculosis, gives the impression that the State is doing a great work, and so it is when we consider that as such problems and movements go, this work is young. But when we consider work already accomplished or that can possibly be accomplished by our present methods and funds in the light of the entire problem, the amount of work done in Minnesota is trivial. To illustrate this, let me suggest that we have a total of nearly 3,000,000 cattle in the State, of which there are 590,000 creamery and city dairy cows and about 60,000 pure-bred cattle. In these classes alone, the most serious classes, we have 650,000 cattle.

At the present rate of 27,216 cattle tested officially last year, it would require about twenty-four years to test the dairy and breeding herds alone, or one hundred and eleven years to test all the cattle in the State. Testing infected herds at intervals of five years, or even two years, for instance, would accomplish very little toward eradication, as every experienced veterinary sanitarian well knows. Testing only these most important classes of cattle once in twenty-four years is accomplishing nothing so far as eradication or effective control work is concerned. We are simply removing a small proportion of the infected cattle capable of disseminating infection. Think of the 142,000 farm cattle barns in Minnesota, and 3650 other barns containing cattle in the State, any of which are possible sources of infection; and, worst of all, we do not know which herds and which stables are disseminating this infection.

Gathered from Study of Individual States.

There appears to be very much to criticize in the best work of the best States so far as actual results are concerned, and many things worthy of praise in the poorest—if we consider age of the work, time, conditions, and opportunities. This study of individual States forces certain conclusions:

It is apparent that the most important among results thus far actually accomplished toward efficient control of bovine tuberculosis has been in the way of public education and the enlistment of a favorable opinion.

1. The work with cattle and stables is fragmentary, unsystematic, and accomplishes little in the way of permanent results, but is perhaps the best that could be reasonably expected up to this time.

2. The best field work being done leaves untested and unprotected a large proportion of the most important classes of cattle, and a large amount of testing is being done with herds capable of doing little harm.

3. Available appropriations are very small, if we consider human lives and live-stock interests to be protected. It should be remembered in considering justification for large appropriations that the live-stock interests are not the only ones involved in live-stock sanitary work, even if we consider only the financial side of the problem and ignore the question of human health. The writer recently heard a large wholesale merchant state in public that jobbers always feel safe in extending large credits to merchants in farming districts where there was plenty of live-stock. When we are protecting live-stock interests, we are protecting to a very important extent the entire commerce of the State or nation.

4. In order that generous appropriations may be had, it is absolutely necessary that the live-stock sanitary control work should be efficient, and should be managed with the most scrupulous economy and honesty and fair treatment, so as to gain and retain the confidence and support of the stock-owner and influential public in general.

5. In order to plan work on a large scale and get results, appropriations must be more stable. A standing annual appropriation upon which a board may depend is to be preferred over larger but uncertain appropriations. This great sanitary problem can never be solved by any temporary measure. Work of permanent value must extend through a term of years. This problem will never be solved in any satisfactory way until it is possible to plan work for years in advance and with the understanding that plans may be carried out.

6. Tuberculin test work which may entitle the owner to reimbursement should be done by veterinarians and their returns accompanied by an affidavit showing definitely just how the test was made and who did it. The sanitary authorities should have a rigid rule concerning tuberculin test that will be accepted, and that rule must be enforced even though in some cases features of the rule may appear to be useless and unnecessarily troublesome.

7. States doing serious work with tuberculosis have had quite enough trouble with tuberculin tests done by veterinarians who know how the work should be done. It does not appear wise to extend this trouble by throwing such work wide open to students and farmers in general, with the State to pay for cattle condemned on such basis, even though some veterinary officer does look over the test records.

8. The writer is convinced, after this study of the work of individual States, that the ideal State organization for this control work consists of a board of about five members, a majority of whom should be ex officio. The secretary and executive officer should be a graduate veterinarian and employed by the board from outside its membership. The board should be composed of veterinarians and prominent owners of live-stock. The members should serve without compensation or opportunity for remunerative employment by the board. The veterinarians and live-stock memberships in their influence on the board, and considering the secretary, should be fairly balanced. I would not have such a board composed exclusively of either veterinarians or live-stock men.

This board should be in close coöperation with the local health officer and boards of township supervisors of the State. Professional politicians should be entirely eliminated, which is not difficult. This board must have ample authority, and should be closely organized in connection with all of the local health officers and township supervisors of the State. Its appropriations must be large and stable.

Eradication.

We frequently hear intelligent people say that all this tuberculosis work is wrong. They say: "You must test all the cattle in the State and

eradicate the disease, and that is the only business-like thing to do." Sweeping plans have been proposed for eradication; but those who propose them do not appear to have had a close view of the great difficulties in the way of actually carrying out such propositions.

The problem of tuberculosis eradication is a very different one from the Federal pleuropneumonia work of some years ago, which cost only the mere trifle of $1,500,000 and five years' time and involved about six States.

The eradication of foot-and-mouth disease cost less than $300,000, including about $129,000 indemnity paid to owners of cattle. Those tasks were but as child's play, and relatively trivial in expense, as compared with the work of eradicating tuberculosis from the United States. These two sums combined would be small in comparison with the cost of eradicating tuberculosis from Minnesota or Wisconsin, or Pennsylvania, or any one of a large number of States.

It is easy enough to insist on complete eradication, and to say, "Away with tuberculosis!" but when one familiar with this class of work sits down to figure, he is appalled by the way figures run into the millions. And even if an unlimited amount of money were available, there are other and almost insurmountable difficulties in the way of complete, rapid eradication under present conditions. To illustrate this the writer will present a careful estimate as to the expense of so eradicating tuberculosis from a single State. Let us use Minnesota for a study of the general problem and as a national problem.

Basis of Calculations.—Calculations are based on the following standards:

Testing all cattle in the State twice a year for two years and annually for the next five years; stable disinfection after each test; reimbursement to owners of one-half appraisal—owner to receive, in addition, the carcass salvage.

The appraisal limits are $78 for pure-breds, $35 for grades; average appraisal for pure-breds $60, and $26.25 for other cattle; average carcass salvage for registered cattle, $13.37; other cattle, $8.79.

There are about 2,993,600 cattle in the State of Minnesota. Two per cent. of these, or 59,872, are estimated for pure-breds; total dairy cows over two years of age, 590,728.

Our Minnesota records show about 37 per cent. of reactions for pure-breds; other cattle, 7.7 per cent. For this present computation the pure-breds are placed at 15 per cent. reactions, dairy and creamery cows at 4 per cent., other cattle 3 per cent. for the first test, and all classes at 0.75 per cent. reactions for subsequent tests. Pure-bred cattle are valued at an average of $60; creamery and dairy cows at $35; other cattle at $20.

Expense of office management for the past year in Minnesota, during which 27,216 cattle were tested officially, was about $70.20 per thousand

tested. Of this $70, $34 was for clerical work and general office expenses. This item would continue nearly a level rate even when dealing with very large numbers of tests. The other item of $36 for executive salary would not increase with the amount of work, but would practically disappear as insignificant in the general rate per thousand; $35 per thousand tests is therefore used as the rate for expense of office management. The best available figure for a neighboring State is $103 per thousand.

Average cost of disinfection per barn, $13; and the barns averaged in 1900, according to census, 13 cattle each.

Cost of test is based on the following:

Veterinarians employed on full time for testing are put at $1200; helpers, $600. Each pair (one helper and one veterinarian) is allowed to keep one horse at State expense, estimated at $150 per year per horse; beyond this they pay their own expenses. Each pair is to make three tests per week, averaging in all sections of the State 25 animals per test, or 75 per week. Enough veterinarians are to be employed for the first two years to test all cattle in the State once in six months. The number of cattle is supposed to remain stationary. After the first two years, one-half as many veterinarians are employed, so as to test annually.

Objection to these calculations may be raised on the ground that it would be unnecessary to test all herds semi-annually for the first two years. True, there would be a rather large percentage of herds showing no reactions on the first general test. But we have no reliable basis upon which to estimate this percentage. If we could make this correction, but one item in the following list, "cost of testing," would be varied, and the general conclusions would not be affected in the slightest degree.

Computing on these bases, we obtain the following startling figures as to losses and expenses of an active and reasonably thorough eradication work:

TOTAL VALUE OF ALL REACTING CATTLE.

For the first year	$3,289,502
For the first two years	4,527,172
For the seven years	7,121,847

TOTAL NET LOSS TO THE CATTLE INTERESTS OF THE STATE (*i. e.*, VALUATION OF ALL CONDEMNED CATTLE LESS THE CARCASS SALVAGE).

For the first year	$1,968,430
For the first two years	2,492,283
For the seven years	3,931,844

NET LOSS TO OWNERS FOR ALL CLASSES OF CATTLE.

During the first year	$965,204.03
During the second year	1,264,988.71
During the seven years	2,014,447.92

COST TO THE STATE (REIMBURSEMENT), ALL CLASSES OF CATTLE.

For the first year	$650,897.23
For the first two years	898,021.51
For the seven years	1,515,831.21

On the basis previously given the cost of testing all classes of cattle by veterinarians and helpers would amount to:

For the first year	$1,893,450
For the first two years	3,786,900
For the seven years	8,520,525

Suppose it is held that this required number of veterinarians is not available, which is quite true, or that it is unnecessary to employ such expensive men to do the work. By employing farm-school students, dairy-school students, farmers, short-course students, and others,—which procedure experienced sanitarians would hardly approve,—we find that the cost of testing all cattle as before would be:

For the first year	$2,019,666
For the first two years	4,039,332
For the seven years	9,088,497

COST OF DISINFECTING ALL STABLES.

For the first year	$4,686,000
For the first two years	9,372,000
For the seven years	21,087,000

COST OF OFFICE MANAGEMENT AT $34 PER THOUSAND TESTS.

For the first year, testing all cattle	$203,564
For the first two years	407,128
For the seven years	916,038

AMOUNT OF TUBERCULIN USED, B. A. I. STANDARD FOR ALL CATTLE.

During the first year, 11,974 liters, or approximately 2994 gallons.
During the first two years, 23,949 liters, or approximately 5987 gallons.
Total for the seven years, 54,885 liters, or approximately 13,471 gallons.

During the past year the government distributed a total of 259,100 c.c. tuberculin, which cost the government to produce about $10 per liter.

To test all the cattle in Minnesota alone on this plan for the first year would require forty-six times this entire Federal output.

The cost of producing tuberculin needed on this plan would be:

During the first year	$119,740
For the first two years	239,490
For the next five years	299,350
Total for the seven years	538,840

Total expense for veterinary services, disinfection, reimbursement, office management, and including the cost of producing tuberculin, which could perhaps be produced by the State at about the same expense as by the government:

For the first year	$7,553,650
For the first two years	14,703,540
For the seven years	35,004,260

The total value of all Minnesota cattle in 1900 was $37,197,198. The present value of Minnesota cattle is probably about $50,000,000. These figures give a careful estimate as to the actual cost of rapidly eradicating tuberculosis from one State only.

The total annual expenditures for all purposes by this State amount to about $6,500,000. Eradication work on this basis during the first year would require considerably more than the entire available resources of the State that year. Can there be any question concerning the hopeless impossibility of rapid eradication under present conditions and with present available agencies? Nor may we reasonably expect complete eradication in the near future. But if absolute eradication, which would be ideal, is unattainable, is it not the part of wisdom to content ourselves with the best work that may be within the limits of reasonable possibilities?

Eventually there will come a time when public sentiment will support thorough and careful work, and when sufficient funds may be secured to carry on a large work. We may yet have a cheap, safe, and efficient vaccine, and other aids unknown at present may then be available. But we must not wait for public sentiment and other conditions to be entirely favorable before making a beginning. The progressive sanitarian must always work somewhat in advance of public sentiment, meanwhile doing his part toward a wise development of public information along intelligently progressive lines.

Solid Ground in Sight.—Thoughtful students of this problem are beginning to ask the question, "What next?"

Those engaged in this work have been wading through an unknown slough for something like fifteen years, and we are beginning to feel that we have found some spots of good, firm ground. There have been developed certain general principles upon which we may base future work.

So far as we can see now, it is evident that comprehensive plans for dealing with the bovine tuberculosis problem must be based upon tuberculin test.

Tuberculin is firmly established as a reasonably accurate diagnostic.

Tuberculosis is now recognized as a serious menace to human health and as an actual source of danger and a constant threat to live-stock financial interests.

It is well established that this is not a disease of breed or type and we are probably well acquainted with the sources and methods of spread.

The principle of indemnity is apparently established as a necessary preliminary procedure.

It is clearly established that one tuberculin test and one disinfection cannot be depended upon to eradicate tuberculosis from an individual stable, and we must plan with this in view when attempting to do thorough work. The classes of cattle which are most actively spreading the infection should be tested first, and this means city dairy cattle, creamery herds, and pure-bred herds.

The first re-test of reacting herds should be given in about six months, and there should be preferably semiannual tests for the first two years, and thereafter annual tests as needed.

There must be adequate disinfection after each test where reacting animals are found.

Stables must be refilled with tested cattle only, or the owner should forfeit his right to future indemnity. There must be used some reliable system of marking that will obviate the probability of fraud.

It is quite clear also that we must have the coöperation of owners and the support of public opinion before anything effective can be accomplished. On the other hand, it will not do to wait for this before making an active start in the work.

Ideal State work employs field veterinarians on full time and in exclusive service rather than deputy or assistant State veterinarians engaged in private practice.

Importation of cattle for dairy and breeding purposes to a State that is undertaking any serious tuberculosis work should be only under the guarantee of a competent tuberculin test.

We must take up the most serious and urgent problem in order, and the work must continue to be something of an evolution.

A Proposition for Control Work.

After a careful study of this problem extending over quite a period, the writer is disposed to suggest a program for dealing with the problem of bovine tuberculosis control.

It is unquestionably desirable to locate, by tagging or otherwise, and deal only with infected herds, but the practical possibility of this on the needed scale has not been demonstrated. There are very difficult problems and complicated details yet to be worked out.

Assuming that a State has a good law and an effective sanitary machine, both having the qualities and features already outlined, I submit the following to be taken up in the order given:

1. In the early history of control work with tuberculosis all resources of energy and money should be concentrated as closely as possible upon importations, dairy and creamery herds, and pure-bred herds. Whenever public sentiment and available funds may justify more thorough work, there should be undertaken what may be as nearly as possible eradication of tuberculosis from these three classes of cattle.

2. The first compulsory testing should be of all herds from which milk is offered for sale in the cities, towns, or villages, with suitable provision for re-testing, refilling with sound cattle, and proper disinfection of the stable.

3. All cattle sold for breeding purposes should be sold with certificates of test or subject to test under such wording of the law as will protect the purchaser against fraud. Compulsory test of all cattle in breeding herds would, of course, be preferable, but there might be question whether it is feasible to force the test for breeding cattle not actually on sale and so long as the cattle remain in the present owner's herd.

4. Compulsory testing of all creamery herds may come third, provided the State has effective provision for pasteurizing creamery skim milk. This should imply suitable re-testing, refilling, and disinfection.

5. Cattle imported for dairy or breeding purposes must come in with satisfactory certificate of test forwarded to the secretary of the sanitary board, or cattle should be held at the first suitable point within the State for testing. Testing imported cattle should be done at the owner's expense, and every possible precaution taken to avoid fraud.

Heavy fines must be imposed upon violators of this provision, and the penalty should fall upon either or both the owner and transportation company.

6. All official testing should be done by veterinarians who are definitely listed and recognized by the sanitary authorities.

The sanitary authorities should define fully and in detail just what constitutes a tuberculin test which will be accepted, and every test record should be accompanied by an affidavit from the one who signs the test records; which affidavit should specify just what and how much the affiant did in connection with the test.

Financial Statement.

A series of computations have been made in order that we may have a clear view of the probable cost of eradication from city dairy, creamery, and pure-bred herds. Knowing approximately the cost, we may more intelligently consider the feasibility of undertaking the work; let it be clearly understood that the following is offered as information that may be useful, and not as work and expense which States are now advised to undertake.

The bases for calculation are the same as for those previously used in studying the possibility of complete eradication.

VALUE OF REACTING CATTLE IN THESE CLASSES.

City Dairy and Creamery.

First year	$982,065
First two years	1,292,165
For seven years	2,067,415

Pure-breds.

First year	$639,882
First two years	1,041,950
For seven years	1,547,120

Total for Both Classes.

First year	$1,621,947
First two years	2,334,115
For seven years	3,614,535

TOTAL NET LOSS TO CATTLE INTERESTS OF THE STATE.

(Total healthy value of condemned cattle minus carcass salvage.)

Creamery and City Dairy.

First year	$660,670
First two years	738,557
For seven years	933,276

Pure-bred Cattle.

First year	$519,808
First two years	571,789
For seven years	831,693

Total, both Classes.

First year	$1,180,478
First two years	1,310,346
For seven years	1,764,969

NET LOSS TO OWNERS.

Pure-bred Cattle.

First year	$219,667.88
First two years	240,588.63
For seven years	222,890.50

Creamery and City Dairy.

First year	$227,895.66
First two years	299,704.80
For seven years	497,222.65

Total of Both Classes.

First year	$447,563.54
First two years	540,293.43
For seven years	772,113.15

NET COST TO STATE FOR REIMBURSEMENT.

Pure-bred Cattle.

First year	$209,387
First two years	230,326
For seven years	282,672

CREAMERY AND CITY DAIRY HERDS.

First year	$176,282
First two years	242,388
For seven years	407,652

TOTAL OF BOTH CLASSES.

First year	$385,669
First two years	472,714
For seven years	690,324

COST OF TESTING.

COST OF TESTING BY VETERINARIANS, CREAMERY, CITY DAIRY, AND PURE-BREDS.

First year	$650,175
First two years	1,300,350
For seven years	2,925,787

The number of veterinarians required for the first two years would be 333, and for the next five years 167.

If it is argued that there are not enough veterinarians available for this work at the proposed salary, and that the work could be done by graduates of agricultural colleges, short-course students, dairy-course students, etc., then the calculation and testing would be as follows. The author would not approve of this method, but will submit the calculation:

COST OF TESTING CREAMERY, CITY HERDS, AND PURE-BREDS.

First year	$550,150
First two years	1,100,300
For seven years	2,475,675

COST OF DISINFECTING STABLES.

(This is on the basis of 50,000 barns for city dairy, creamery, and pure-bred herds, which is very nearly correct for Minnesota.)

First year	$650,000
First two years	1,300,000
For seven years	2,925,000

COST OF OFFICE MANAGEMENT.

(For creamery, city dairy, and pure-bred cattle at $34 per thousand tests—possibly high for work on large scale.)

First year	$44,200
First two years	88,400
Seven years	198,900

AMOUNT OF TUBERCULIN USED AND COST.

CREAMERY, CITY DAIRY, AND PURE-BRED CATTLE.

First year, about 2600 liters, or 650 gallons, costing	$26,000
First two years, 5200 liters, or 1300 gallons, costing	52,000
For the seven years, 11,700 liters, or 2925 gallons, costing	117,000

TOTAL COST OF ERADICATION.

These figures indicate that the total cost of eradication in seven years on this basis and from these classes—city dairy, creamery, and pure-bred herds—would be as follows:

First year	$1,756,040
First two years	3,213,460
For the seven years	6,857,000

Data.—It is interesting to note in this connection that on this basis there is required 0.5 of a gallon B. A. I. tuberculin per thousand cattle per test.

Testing by veterinarians would cost, on the basis previously given, very nearly 50 cents per head. Testing by farm school graduates, etc., would cost about 43 cents per head.

The cost of disinfection on the basis given amounts almost exactly to $1.00 for each animal tested for each disinfection.

It is possible that some more economical plan for utilizing tuberculous cattle than by slaughter and carcass salvage may be developed.

This may come with tuberculosis stock farms under private management, licensed by the county or State: or possibly with tuberculosis farms managed directly by the county or State. No difference what form this plan may assume, it is safe to say that it will receive a royal welcome after it has "made good," as we say in American phrase.

In order to stand test, any plan for utilizing tuberculous cattle must answer favorably to one difficult question: Is it profitable in cold dollars? Can tuberculous cattle, whether mixed grades or pure-breds of many breeds, be purchased at the average price of carcass salvage and then be managed profitably in the United States, with the products honestly labeled and competing in the open market with similar products from healthy cattle?

With this question in mind, the writer has been unable to formulate anything that would stand careful analysis. Neither has any method suggested by others come under observation that does not appear hopelessly impracticable. Several have suggested plans, some features of which may yet be utilized, and we may all wish earnestly that something better may appear.

In Conclusion.—It need not be argued in this connection as to whether vigorous control work on a large scale should be done by the State alone or by the State with Federal aid, or whether by Federal authorities chiefly. Abrogation of police powers of a State involves legal questions which need not enter into this discussion. But whether this final work of eradicating tuberculosis from these three classes of cattle is to be undertaken by the State alone, or by the State with generous Federal aid, it is very evident that the work must be done with individual States as units.

Hitherto there has been too much theorizing and too much guessing. Students of this problem have been dealing too much with glittering generalities. It seems high time for us to develop some tried bases for more efficient work; time for statements of basic principles and quite time to outline large plans. Our owners and consumers and legislators are entitled to practical plans and prosy statements of probable cost and probable results.

Let us all—all who are directly interested in this problem and familiar

with it—endeavor to work out practical methods of doing much larger and much more efficient work than we have been doing.

> "Still achieving; still pursuing,
> Learn to labor, and to wait."

DISCUSSION.

Mr. F. O. Beall (Maine): I beg to make some exceptions to some of the statements in this paper. The author speaks of the best States in the Union, and refers to Massachusetts. He also speaks of them as the pioneers in eradicating tuberculosis. I would like to say that we were pretty nearly the pioneers in this work, as we started in the sixties to eradicate bovine tuberculosis from our State, and we are getting satisfactory results. We have laws to uphold us in anything we wish. There is a law in Maine that does not allow cattle to be brought from any other State or territory without first having a special permit from the cattle commissioners. We have so schooled the people of our State that they are demanding the tuberculin testing of their cattle—it is more work than we can do. We have educated the people to the danger of tuberculosis, so that they are desirous of eradicating it from their herds entirely. We have brought them up so as not to expect any salvage for their slaughtered animals. We have also taught them that it is dangerous to consume tuberculous meat.

Mr. Gordon (Washington, D. C.): With reference to the tuberculin test, I was the first man in Pennsylvania to use it, and I have been using it ever since. I believe it is a most efficient way by which to keep a herd clean and free from tuberculosis. I have had twenty-three years' experience with it, and I do not think that this Congress need apologize for its use.

Mr. A. E. Kepford (Iowa): I think that this paper presents one of the most important features of the discussion before this Congress, and especially is this true with reference to States like Iowa. In a fight against human tuberculosis we must recognize bovine tuberculosis as a great contributory cause. For the last few years I have lectured on the subject of tuberculosis, and I am very much interested in Dr. Reynolds' paper. I want to know what measures we are going to resort to in the control of bovine tuberculosis. The stupendous figures mentioned in his paper in connection with the expense of eradicating bovine tuberculosis cast a very gloomy aspect over the problem. It seems to me that there should be come sort of Federal commission that could have control over this bovine scourge. It seems that we lack coherency, and that there should be arrived at in this Congress some coherent method for handling the subject. With reference to tuberculosis among the people, of course, it is wise to teach the people of Iowa the cause and prevention of the disease, but in an agricultural State like Iowa it is

necessary that there should be some coherent action with reference to the transmission of bovine tuberculosis. The matter of salvage should not be considered, or in its consideration there should be no provision for reimbursement for diseased meat.

Dr. Kinyoun (District of Columbia): There are two government agencies which could be used for tuberculosis control—the Bureau of Animal Industry, to prevent cattle coming from one State to another, and also the Bureau of Chemistry, in the control of dairy food-products. Under the recent law, the pure food and drugs act, the Bureau of Chemistry can take action in these matters. The control of milk is practically operative under this law. I fully agree that something should be done for the control of tuberculosis in animals, because I am one who believes that it is a menace to the human race. It will in all probability have to be handled by some governmental control. In view of the fact that millions of dollars have been spent by the national government in eradicating pleuropneumonia and foot-and-mouth disease in the United States, in which instance the farmers were repaid for animals destroyed, I really believe that a precedent would not be established by the government in giving some partial remuneration in the eradication of this great scourge. In the latter case the public health is also concerned. I think the money would be well expended if we could get our herds freed from tuberculosis.

Mr. Beall (Maine): I stated that the people of Maine had been educated to the point where they did not believe the meat of tuberculous animals was fit for food, and therefore they will not use it. The United States Supreme Court has decided that each State by itself may control and keep other animals out of the State, and do anything that will be beneficial to the health of the people.

Dr. Rutherford: There are two aspects of this case which it is well to get differentiated in our minds—one is the control of bovine tuberculosis, and the other is the protection of human beings from meat and milk of tuberculous cattle. The two subjects are quite separate and distinct. I think the health officers should confine themselves to safeguarding the people by preventing the sale of milk coming from dairies which are infected. This is done in a number of communities in Canada and in other States. The tuberculous cows are taken out of the herds and proper sanitary precautions are taken, such as disinfection, etc.

At the conclusion of this discussion the Section agreed that extra sessions should be held on Saturday to hear the remaining papers, and to conclude the discussion of the control of tuberculosis in animals.

SECTION VII.

Tuberculosis in Animals and Its Relations to Man.—(*Continued.*)

NINTH SESSION.

Saturday, October 3, 1908.

CONTINUING THE DISCUSSION OF THE CONTROL OF TUBERCULOSIS IN ANIMALS.

The Section was called to order by the President, Dr. Leonard Pearson, at nine o'clock. At a quarter to eleven o'clock a recess was taken for the sake of attending the closing ceremonies in the Assembly Hall.

PRECAUTIONARY SANITARY LEGISLATION AGAINST TUBERCULOSIS OF THE DOMESTICATED ANIMALS IN THE UNITED STATES.

By D. Arthur Hughes, M.Litt., Ph.D., D.V.M.,
Inspector, Subsistence Department, United States Army, Chicago.

I. The Resolution Referring to Tuberculosis of the Domesticated Animals Passed by the International Congress on Tuberculosis Held in Paris, 1905.

The question of intertransmissibility of bovine and animal tuberculosis has been so much a matter of agitation during the sessions of previous International Congresses on Tuberculosis, and its unsettlement has caused so much anxiety in the popular mind, that it may not be out of place, at the outset, to remind Section VII of the Congress of 1908 of the resolution passed by the Paris Congress in 1905. That resolution read as follows:

"The Congress, after hearing the exposé of the most recent investigations, declares that it is not only indispensable to avoid contagion from

man to man, but also to pursue the prophylaxis of bovine tuberculosis, and to continue to take administrative and hygienic measures to avert its possible transmission to our species, and, finally, that it is desirable to be on our guard against all forms of animal tuberculosis."

This resolution, similar as it is to previous resolutions, in view of the lack of unanimity on the question of intertransmissibility, was happily worded, and wisdom was shown in its passage. Its contents are short and to the point. Its meaning, as understood by us, on this side of the Atlantic, is clear. Its chief note, because of the lack of complete unanimity on intertransmissibility, was *precaution.* It called for the continuation of sanitary law, in the several countries where statutes were operative against the disease, and it implied the necessity for the erection of similar sanitary legal precautions against tuberculosis of the domesticated animals. There has been, up to the present hour, a general disagreement with the views expressed by Prof. Dr. Koch in the London Conference, 1901, and reiterated by him in the Nobel lecture, in part, in Stockholm, December, 1905. As the question of the interrelation of human and bovine tuberculosis is still an open one, there is wisdom in not slacking precautionary measures against tuberculosis of the domesticated animals.

II. The General Sympathy of Sanitarians, in all Parts of the United States, with the Resolution on Animal Tuberculosis Passed by the Congress in Paris.

The position taken by American sanitarians regarding the possible danger of tuberculosis of the domesticated animals to man has, in the past, as in the present, been the same. There has been a general sympathy of all our medical men, whether practising human or comparative medicine, of our investigators, teachers, and writers, with the view corruscated by the Paris Congress in its resolution, and by the previous congresses in theirs. Because of this sympathy, action has been taken by framers of sanitary law, and by sanitarians who administered laws passed, to see that things were done in accordance with the views of that representative body of specialists on the disease which met in the French capital. When I speak of sanitarians, I mean the large body of men of position and power of every sort interested in questions of public health in America—investigators in national, State, and private laboratories, in universities, colleges, and special scientific schools, human medical and veterinary medical teachers, advisers and practitioners, national and State administrators of sanitary law, publicists in general—all have had the conviction that, in view of our lack of sufficient knowledge, on the interrelation and intertransmissibility of the disease, it was best to safeguard fully public interests against the scourge, and, for the present at least, not to slack any law or regulation against human or animal forms of the disease.

The chief of these sanitarians may be grouped as: (1) Those acting under the general or central government; (2) those acting under the governments of the individual States included in the United States; (3) those acting under municipalities in the individual States included in the United States. And in speaking of these groups of sanitarians, we pass to:

III. The Agencies for the Control of Tuberculosis of the Domesticated Animals in the United States.

We may speak, first, of the national government's agencies for the control of the disease in animals.

The source of power for the control of disease among animals by the Federal government is traceable to the written constitution of the United States, which was agreed to by the American colonies in the eighteenth century at the foundation of the government. In it Congress is given power to control commerce between the States composing the United States. There has been much written in interpretation of this provision of the Constitution by writers on constitutional law. If Congress does not enact special legislation governing any form of interstate trade questions, it is held that the individual States may pass laws, at their will, covering their trade with contiguous States and territories. For instance, any State may pass a live-stock sanitary law governing the movement of animals to or from its borders. But as, in reality, the right to enact legislation with regard to interstate questions, the movement of animals between the individual States as well, belongs, by the Constitution, to the general government, the laws of the individual States must give way whenever Congress passes law assuming control.

Up to the year 1884 Congress had not assumed the power over interstate trade in animals. In that year the alarm caused by the prevalence of pleuropneumonia among cattle led to the foundation, by the national legislature, of the Bureau of Animal Industry and complete assumption of control over this branch of the trade. The original purpose of this fundamental act was the control of pleuropneumonia. Still, it was made the duty of the new national agency to investigate, prevent, and control all other contagious, infectious, and communicable diseases of animals. Power was vested in it to move against all dangerous animal infections in the United States. Its scope was made large enough to include all animal plagues. In short, this national agency may, under certain exigencies, assume control of tuberculosis of domesticated animals in its interstate bearings, and may go as far with tuberculosis as it has already done with other animal infections—that is, may suppress it. However, in common with all national agencies for the control of disease, it has, at present, limitations to the use of its power, or limitations which check its power. The ignorance of the populace of the

diseases of animals, like tuberculosis, causes the national agency to halt in its work until the balm of intelligence has sufficiently leavened the masses to allow it to proceed. For the work of prevention of disease is dependent upon the expenditure of large sums of money for exploitation, prevention, control, and appraisement. Money will not be appropriated, nor will the bulwarks of prejudice and opposition to scientific purpose be broken down, until there is a general, unified national feeling and action against such a disease as tuberculosis.

Pending the time when public sentiment would permit its assumption of full power against this disease, and when appropriations of money would allow it to take charge of control work and suppression, this national agency has, in its past and present endeavors in regard to tuberculosis of the domesticated animals, exhibited a commendable spirit in its investigations of questions relating to the disease in its Washington laboratories, in the initiatory field work undertaken in the United States Meat Inspection Service conducted by it.

For a number of years the laboratory work of this national Bureau and the work of the experimental farm in the vicinity of Washington have been devoted to studies of the interrelation of various forms of tuberculosis and the varied virulence of the bacilli of different origins. But the circulars and bulletins containing the results of this work have been given the widest circulation possible, even in the remotest corners of this western continent. Besides, the educational propaganda have included valuable artistically illustrated papers published in the Bureau of Animal Industry annual reports and the year books of the Department of Agriculture. One of the Washington laboratories of this Bureau, the biochemical, manufactures large quantities of standardized tuberculin and distributes it freely among the sanitary officers of the individual States, stipulating that the results of each test be sent in to Washington for filing, in order that a statistical study may be made of the extent of tuberculosis in the United States. Acting under the United States Meat Inspection law of June 30, 1906, this national agency has, in the fiscal year 1907, condemned and disposed of 19,305 whole carcasses of cattle and 10,530 parts of cattle for tuberculosis, and 65,618 carcasses of swine and 364,559 parts of carcasses of swine for the same disease. This work was conducted in 708 meat establishments in 186 cities, where a total of 32,000,000 cattle were inspected and a total of 32,000,000 swine.

The second group of agencies acting against tuberculosis of domesticated animals in America are the agencies instituted, within their own confines, by the governments of the individual States included in the United States, for the control of the disease. The power of each State to control the disease within its own borders is dependent upon the power conferred by the constitution adopted by the people of the State, when its population became large

enough to permit admission of the territory as a State into the American federation. Each State has, under the Constitution, a limited sovereignty covering purely State affairs. Each State has sovereignty only within its own confines, consequently self-limiting. The agencies for sanitary control work among live-stock in the individual States differ greatly, according to the power granted by the State constitution, or depending upon legislative idiosyncrasy. Usually the agency consists of a board of sanitary officers appointed by the governor of the State and accountable to him, the membership of which may, or may not, contain a veterinarian or veterinarians, though commonly the board contains an administrative officer called the State veterinarian. The general purpose of this live-stock sanitary board is indicated by its name—under the governor of the State and the council it administers the sanitary laws of the State. As the live-stock sanitary laws of each State differ greatly in text and purpose, the work of the board is equally simple or complex, according to circumstances. The authority and effectiveness of the live-stock sanitary laws are limited to the State in which they are passed. At the present time the warfare against tuberculosis of the domesticated animals in America is, for the most part, conducted under the provisions of the live-stock sanitary law of the individual States and territories included in the United States, and presently it will be my pleasure to depict, as truthfully as I can, the conditions which prevail under the operations of those laws.

The third governmental agency working against animal tuberculosis is that of the American municipalities. Their power is, of course, much more limited than that of the agency of the State, for ordinances can only refer to their own area. City ordinances aimed at tuberculosis of animal origin must cover chiefly live animals, meat and meat food-products, and milk with specific regulations on goods vended or intended for sale within their limits. The passage of city ordinances directed largely against products infected with tubercle bacilli depends greatly on enlightened public opinion locally. A good deal of work has been done, and is being done, by American municipalities for control of animal tuberculosis, by repudiation of infected products and by prohibition of their sale. The flamboyant city press which describes the nastiness of dairy conditions or the impurity of the milk-supply; the question of infection agitated by the local medical authorities, the medical societies, or in the social circle, have borne fruition in local ordinances. The force of example set by enlightened cities has helped in the formation of State sanitary law. In very many of the States may be found from one or two to numerous towns blessed with such regulations under medical and bacteriological administration. Usually the laws have their origin in the discovery of gross tubercular infection of the dairies supplying the town, and the regulations are aimed chiefly against tuberculosis. This is the case, for ex-

ample, in such widely separated towns as Portland, Maine; Shreveport, Louisiana; Omaha, Nebraska; Fort Smith, Arkansas; Grand Forks, North Dakota; Duluth, Minnesota; in many towns in South Carolina, Colorado, and Montana. The possibilities for good, through the medium of this agency, in city ordinances directed against tuberculosis of the domesticated animals, depend upon the understanding of the citizens of the dangers possible should infection with the disease take place.

But the work accomplishable by these three groups of agencies against animal tuberculosis in the western world—the national agencies, those of the individual States, and those of the municipalities within the States—are beset with many trials. We may now pass, therefore, to:

IV. The Difficulties with which any Movement in the United States for the Control of Tuberculosis in the Domesticated Animals must Contend.

In treating this portion of my subject I may be permitted to place before you the difficulties, helter-skelter, just as they occurred to me, with comment as I proceed.

It is comparatively easy, in small countries like Denmark or Holland, to deal with an infection like tuberculosis. But when we are reminded that the United States has an extent of territory apparently equal in area to that of the whole of Europe, the truth is made graphic that extent of territory is the first difficulty with which we have to contend.

Again, in the United States are found the most varied agricultural conditions, vast herds bred for every purpose and numbering many millions of animals, rapid transit of animals, an enormous interstate and export animal industry.

Further, we have many varieties of climate, causing the economic conditions of breeding, feeding, and housing of animals to vary, and increasing the complexity of the problem of dealing with animal tuberculosis.

Furthermore, the country is new and unsettled conditions prevail. There are still millions of acres unsettled, open ranges of private ownership, State-owned or owned by the nation; places in many States where the cattle, privately owned, are stabled or corraled part of the year, and run at large other parts of the year. There is an intermixing of animals of all sorts, regardless of means or possibilities of infection.

No doubt the wonderful immigration to the United States within the last half century has had much to do with the increase of animal tuberculosis. The teeming millions of Europe, many of which are from the lowest peasant class, settling large agricultural sections of the country and ignorant of the disease, have not helped in its control.

Till thirty or forty years ago the United States, of all countries, had the

least information on veterinary science. Even now veterinary education in America is almost a new thing. Our schools are few, for a continent such as ours is, and widely scattered. The American continent is sparsely settled with veterinary practitioners worthy of the name. The proportion of veterinary graduates or veterinary practitioners compared with human medical graduates or practitioners is amusingly small. Veterinary teachers are only a hundred or two, and many of them are not particularly well taught nor particularly skilful in their specialties. The number of eminent American veterinarians is very few indeed. Of great writers on veterinary science we have hardly any. The widely prevailing ignorance of veterinary science is one of the chief difficulties with which we have to contend in controlling animal tuberculosis.

Moreover, in some places, where, indeed, the people have been taught the dangers of animal tuberculosis for years, there is a stolid indifference to the consequences of carelessness in the matter of this infection. New York State, for example, has had the benefit of the voice and pen of earnest specialists, eminent for their knowledge of animal tuberculosis, for a quarter of a century. Yet, even so late as the past winter, though bovine tuberculosis was shown to be rampant,and his excellency, Charles Evans Hughes, governor of the State, in his annual message to the legislature, recommended a State meat inspection service to aid in its control, none was granted.

Conflicting views on the disease are held in various sections of the country by scientists and others. The human medical profession strenuously maintains the infectiousness of the disease for the human family. Yet, strange to say, they do not take hold of the idea of the infectiousness of bovine tuberculosis with the same anxiety or avidity, for the reason that the dispute over transmissibility of the disease has unsettled many minds.

In the different States conflicting methods of fighting animal tuberculosis are in vogue. In some States there is a lack of information of the extent of the disease among domesticated animals. Worse still,—for example, in Michigan,—the State sanitary officers give positive assurance of the absence of the disease among farm animals in parts of the State. No doubt in many cases such statements are misleading, if not false. Michigan has many cities in its midst—for example, Detroit, Lansing, Saginaw—which would require many dairy herds for their milk-supply, and dairy herds are apt to be notoriously tuberculous.

Many States have no law adequate to control tuberculosis among animals. Still others have adequate law for its control, but they have no money, or insufficient funds at least, provided by the legislature to carry out the law. For example, in the State of Minnesota, which can boast of a splendid system of sanitary control of tuberculosis, the citizens who have animals condemned for the disease, after appraisement have to wait a year or two

for the money awarded to them, because of lack of appropriation by the legislature to make payment for appraised animals.

In many States there are conflicting views on methods of disposition of tuberculous animals or of tuberculous carcasses. Some hold that the carcasses must be burned or buried; others that they may be sold to slaughter-houses and reimbursement given according to the extent of the tubercular lesions. Some States hold that tubercular carcasses have no money value; others that they have a varying worth of from $15 a piece to 40 or 75 per cent. of their market value had they not been tuberculous.

In some States sanitary officers are placed in power, but are not given sufficient prerogatives to control the disease; in still others the officer's hands are tied by conflicting articles in the law, practically nullifying effective work.

Some States have no live-stock sanitary officers, legally constituted, at all. In others the power to control animal tuberculosis is vested in a sanitary board consisting entirely of political farmers, ignorant of the disease—that is, no veterinarians are officially placed on the board by the law.

In some States, again, heavy administrative burdens are entailed on State sanitary officers, whereby it is impossible for them to do their full duty with regard to animal tuberculosis. The States with adequate law against bovine tuberculosis sometimes have States on their borders without such law. Hence it comes to pass that cattle known to be tuberculous in States having strong sanitary law are spirited away and sold in the adjoining States without law against the disease. Again, there is, in sanitary matters, apparently little feeling of sisterhood between the States—States with excellent sanitary laws mentioning in their reports conditions in neighboring States and setting up a blockade against the animals of those States, having the semblance of procedure in legal enactment against a foreign State or a foreign country.

One finds an unwillingness of States containing great cities, or having great cities neighboring them in other States, where there is a large trade in domesticated animals, to set up sanitary law against the perilous commerce in tubercular animals. Very few States control the butcher trade in small towns, where so many tubercular cattle are killed, or the trade along the public roads, or over railroads, intrastate or interstate.

The most conflicting views prevail in different States on tuberculin as a diagnostic agent. Tuberculin sold is often not standardized. What is sold is that from private companies, State laboratories, or United States laboratories. No wonder many tests are failures, when spurious material is sold for tuberculin. There is conflict of opinion in the various States on methods of diagnosing the disease: some requiring tuberculin; others permitting it; others not requiring it at all. There are diverse laws on the

control of the disease. The States seem to be all at sea as regards methods of control, some advocating the Bang method; others the slaughter method. There is much dispute as to the practicability of the Bang method for our agricultural conditions and much criticism of the costliness of the slaughter method.

There is lack of Federal control of the milk, butter, and general dairy trade in products which are well known to be liable to infection with the tubercle bacilli. Nor is there sufficient State or city control of the trade in milk and butter infected with tuberculosis. Private practitioners in the rural regions fear the loss of their clients, when tuberculosis is known to be in herds, and are willing to stand by their clients, though their scientific knowledge tells them they should not do so. The farm element often opposes control or suppression of tuberculosis by covering their knowledge of its presence in herds, either from disbelief in its infectiousness, from fear of losses by reduction of prices, or from fear of losses in sale of milk in the community.

The States in which sufficient authority is granted live-stock sanitary officers to control tuberculosis in the domesticated animals have not, as a body, risen to a lofty conception of the interstate and national significance of the disease, the consequence of which is a lack of unified feeling and unified opinion among State officers, taken as a whole, upon the largeness of the problem of control, of its national and continental bearings. The live-stock sanitary officers have not sat in continental convention upon the control of the disease, nor have the Canadas, nor Mexico, been invited to confer upon it.

Here the question may be asked, Are the domesticated animals in America so much infected as to necessitate such serious council? In reply we should say that tuberculosis is of the greatest moment as a live-stock sanitary problem in the United States, which may be discovered from even a cursory study of the situation.

V. The Prevalence of Tuberculosis among Domesticated Animals in the United States.

Precautionary sanitary legislation against tuberculosis of the domesticated animals in the United States is needed because of the wide prevalence of the disease and its undoubted increase among cattle and swine—the two chief kinds of food-producing animals. In speaking on the subject of the prevalence of animal tuberculosis we must freely admit, at the start, that, on account of the fact that many of the States are not given to taking accurate statistics of tubercular animals, our knowledge of the prevalence of the disease is imperfect. Nevertheless we have sufficient data to convince us that the disease is covertly, but markedly, advancing—so much as to cause alarm for the future.

We have, to sustain this opinion, three sources of evidence: namely, the evidence furnished by the United States Meat Inspection Service; the evidence furnished in the facts turned in to Washington from the States to which tuberculin has been for years distributed freely from the Federal laboratories; and, lastly, the evidence collected by State officers in their official capacity.

A short time ago Russell and Hastings, of the Wisconsin Agricultural Experiment Station, published statistics based upon a study of tuberculin tests of cattle in several States. They may be given here as illustration of the amount of infection in some quarters several years ago:

State	Number Tested	Number Tubercular	Percentage Tubercular
Vermont	60,000	2,390	3.9
Massachusetts	24,000	12,443	50.0
Massachusetts, entire herds	4,093	1,089	26.4
Connecticut	6,300	..	14.2
New York (1894)	1,200	163	18.4
New York (1897–1898)	34,000	4,800	14.1
Pennsylvania	2,500	..	21.4
New Jersey	929	..	12.0
Illinois (1897–1898)	3,655	560	15.32
Michigan	..	..	13.0
Minnesota	3,430	..	11.1
Iowa	873	122	13.8
Wisconsin Experiment Station herds	323	115	35.6
Wisconsin, non-suspected herds	935	84	9.0
Wisconsin, State veterinarian's tests (suspected herds)	588	191	32.5

Recent figures are not at hand to illustrate the increase in tuberculosis in these States, except New York. But figures from New York are interesting, intensely so, as it is by far the largest dairy State, having a total of 1,755,972 milch-cows. Between 1904 and 1906, in tests made under the direction of the commissioner in a large share of the counties of the State, the following results were obtained: 262 herds tested; 3088 cattle; 673 reacting; 21.79 per cent. tuberculous. Between 1905 and 1907 statistics were taken by private practitioners of tests covering most of the counties in the same State, with the following results: 364 herds tested; 8640 cattle; 3111 cattle reacting; 36 per cent. tuberculous. This warrants the conclusion that tuberculosis is wide-spread in the largest dairying State in the United States, and is rapidly increasing, and that, though but ½ of 1 per cent. of New York's cattle have ever been tested, all are more or less seriously affected.

The evidence furnished in the facts turned in to Washington from the States in which tuberculin has been for the last few years distributed freely

by the Federal government is also striking; for, whenever tuberculin was furnished to any point in the country by the Washington authorities, they always stipulated that the results of the tests should be sent to the capital for filing. In this manner a tally has been kept on the increase of tuberculosis throughout the country. From the statistics thus filed it has been determined that of all cows in different States throughout the country tested with tuberculin furnished by the national government, from 2.79 to 19.69 per cent. are tuberculous, as shown in reaction and slaughter.

Perhaps the evidence for safest judgment in the spread of tuberculosis among American cattle is furnished by the United States Meat Inspection Service. The government reports show that, from the year 1903 to the year 1907, there has been an increase in the number of cases of tuberculosis found in the post-mortem examinations, conducted in meat establishments by United States inspectors, from 0.169 per cent. in 1903 to 0.539 per cent. in 1907, that is, about three times as much. In swine the same conditions prevail, except that four times the amount of infection is found in swine that was found five years ago. It must be remembered that this amount of infection was discovered in the 8,000,000 cattle and 32,000,000 swine examined post mortem and coming from nearly every State in the nation. If anything, the increase of tuberculosis during the last five years among domesticated animals in the United States is greater than the percentages I have given would indicate; because the United States inspectors hold post-mortem examinations on only five-eighths of all cattle and swine killed in the United States per annum. The remaining three-eighths, or 30,000,000 animals, are killed without inspection, on the farms and under unofficial conditions, where nothing can be known of tubercular lesions among them.

In view of the evidence from State government and national government sources which has been presented, the conclusion cannot be avoided that tuberculosis is increasing rapidly among domesticated animals in America. We may, therefore, now properly consider:

VI. What has Been Done, or is Being Done in the Individual States Included in the United States, for the Control of Tuberculosis of the Domesticated Animals.

Though the question of animal tuberculosis has, for a long time, assumed the proportions of a national question, it has never been attacked by the majority of our scientists as a national question. The faultiness of this is self-evident; though there are numerous reasons, or what purport to be reasons, for delay—the subtly working, unobtrusive nature of the disease, whereby it is not known to be present; our ignorance of the extent of its prevalence; the staggering loss of treasure which would be the price of its eradication. Instead of assuming the burden nationally, we have left the

problem to be attacked by individual State governments and locally within the States.

The warfare against the disease has taken initiative, or has been dependent, perhaps, upon the accidental discovery of its presence in the State; perhaps upon the multiplication of municipalities, accompanied by an increase of human tuberculosis, and the belief that animal as well as human tuberculosis should be cudgeled; or the multiplication of dairies has drawn attention to a rapidly increasing animal tuberculosis; or the preference for pure-bred cattle some day reveals the presence of the infection among many of them. Though, usually, the warfare against the disease in the States or locally has been due to the influence of educated men, mainly veterinarians, whether State sanitary officers or not, who have become awakened to the extent of the disease among animals within the State boundaries, and, with every drop of missionary blood in their veins burning with zeal, have urged precautionary measures against it and all other dangerous communicable diseases.

Whatever manner the control movement has been initiated in the several States matters not, so long as this creditable work is done at all. In surveying the continent as a whole, to note what is being done against animal tuberculosis, the work presents remarkable geographic features. Consequently we may consider the States in groups according to their geographic situation.

The first group consists of the New England States—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

1. *Control Work Against Animal Tuberculosis in New England.*—This group of States, all of which were settled very early in the history of the country, together has the smallest area of any group of States in the land. Their early settlement, the intelligence of an academic sort which prevails in New England, would lead one to suppose that control work against animal tuberculosis would be of a high order. Contrary to such expectations, in a general way it may be said and must be admitted that proud New England is very backward in veterinary sanitary control work. There are numerous thriving manufacturing towns in this group of States, supplied by a multitude of dairies. Yet the sanitary laws are all very faulty, and laxity and incoördination in sanitary work prevail. The States do not work hand in hand to control the disease. Rather, there is no mutual understanding. One State seems to be halting for the other to do something. The live-stock sanitary boards, with the exception of Massachusetts, are not headed by veterinarians. The heads are all more or less conscientious. But what work is done is muddle-headed and stupid—rather that of political gamesters than of scientifically trained men. It is amusing to read some of the sanitary reports to the governors—the uneducated babble of farmers trying to make

out reports on the prevalence of disease. The New England universities are still too much engrossed with medieval and modern classical scholasticism to train veterinarians for the agricultural needs of the States. Hence the situation of affairs I have described.

Maine has a law, aimed at tuberculosis, in which appraisal of an animal is prohibited unless it has been owned in the State for three years. The purpose of the law is to discountenance the importation of tuberculous animals, instead of which it probably leads to the concealment of the disease by owners. The large city of Portland in 1906 got up in arms against the vending of tuberculous milk, the consequence of which was that tuberculin tests, made by the State Board of Cattle Commissioners, showed that 16½ per cent. of all cattle in the vicinage were tuberculous. The Board has a supposition that dairy cattle supplying other municipalities are similarly affected. The law requires that all pure-bred cattle imported must be tested under the order of the commissioners within thirty days after arrival. Pure-bred cattle sold within the State must be tested before delivery.

The report of the cattle commissioners of New Hampshire displays the absurd fact that a physical examination only, without the tuberculin test, is all that is required to pass animals into New Hampshire. Reimbursement is given in the State for animals found on physical examination to be tuberculous; that is, New Hampshire waits until the tuberculous animal has done its worst and is rapidly approaching death before it acts.

The live-stock sanitary law of Rhode Island is flimsy, inchoate, and superficial, though it cannot be believed that this law answers even for so pigmy a State as this. Apparently Rhode Island waits until there is a suspicion that a single animal is tuberculous before it rushes to act. Evidently the plan is similar to that of New Hampshire. The single bad animal, in a state of easily observed physical wreck, is all that is asked for. No tuberculin tests are required.

The law of Connecticut is a very poor one. The commissioner, who in his report shows very imperfect information on tuberculosis, and vents ideas totally in opposition to scientific truth, regrets that he has no State authority over sanitation of dairies. The reports for the last seven years show a gradually increasing number of condemnations for tuberculosis, and, it is added, "if the size of the counties and the number of neat cattle kept in each county are taken into consideration by reason of locality, it will be seen that no county can claim any appreciable freedom from bovine tuberculosis."

In contrast to these States, Massachusetts has an excellent system of live-stock sanitation, undoubtedly owing its present existence, its increasing usefulness, its wide-awake activity, its air of modernity and intelligence, to the chief of the Cattle Bureau of the State Board of Agriculture, Dr. Austin Peters, of Boston, who is a veterinarian of English training inured to Amer-

ican agricultural conditions. Animal tuberculosis in Massachusetts is looked after with knowledge of its nature, its seriousness, its destructiveness.

The work against the disease in that State has three aspects: First, the examination, condemnation, or releasing of animals held by local inspectors of the State under suspicion of being tuberculous. Second, the quarantine work against tuberculosis, which is a requirement of the State board. This has two parts—the testing for tuberculosis of all cattle brought into the three important quarantine stock-yards, Brighton, Watertown, and Somerville, in which class of cattle no certificates of tests made outside the State are accepted; and the testing of cattle brought to points just outside the quarantine stations. If these have had no test, they are injected at the owner's risk, in order that those tubercle-free may be sold in the yards. Third, the testing of entire herds by the board at the owner's request, with the object of eradicating tuberculosis from them. Fortunate in these three respects as Massachusetts is, its system is defective in that: first, there is no compulsory testing of cattle (herds) outside the three quarantine areas; second, there is no mandatory meat inspection; third, as the licensing of slaughter-houses, though obligatory, has proved farcical, much tuberculous meat is sold in large sections of the State.

2. *Control Work Against Animal Tuberculosis in the Atlantic States.*—Though, on the whole, control work against the disease in the Atlantic States—New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, North and South Carolina—is better than in New England, much is left to be desired.

The abominable conditions in the State of New York have already been treated in another section of this paper. Only during the past winter was a Bureau of Veterinary Service instituted under the State Department of Agriculture, with a chief State veterinarian officially placed at the head with a good salary. The State requires the tuberculin testing of all cattle entering the State, except those coming with official certificates from other States. It tests, on request, cattle for tuberculosis, where this is suspected, and the owner may, at his option, adopt the Bang method for the perpetuity of his cattle, or submit to their slaughter and destruction, after an appraisement and award of all reacting cattle. However, there is no system of State meat inspection; no compulsory testing of cattle.

The work against animal tuberculosis in New Jersey is in the hands of the State Tuberculosis Commission. The law regarding the entrance of cattle into the State is similar to that of Pennsylvania. New Jersey gives free entrance to cattle, duly inspected in another State, when brought into that State. It accepts cattle duly tested by State agents, other than its own, provided a properly signed duplicate certificate is made out and sent to the commission for approval, accompanied by a copy of the tempera-

ture chart, duly signed by the authorized agent. If cattle, without such certificates, wish to enter, they must be held in quarantine at destination in the State prior to test with tuberculin. Tuberculous cattle are either turned back or destroyed at the expense of the owner without appraisal. Cattle within the State are tested on request and appraisal given tuberculous cattle, provided a veterinary physical examination be made at the owner's cost, prior to the State's tuberculin test in order to avoid unnecessary testing.

The banner State of the eastern part of the United States in the control of animal tuberculosis, as well as all other animal infections, is undoubtedly Pennsylvania. We may well expect the President of Section VII of this Congress to report the progress that that State is making in control work under his leadership; so I will not usurp his rights in that matter. However, in passing, I may say that because of the reign of sanitary law over the stock interests of Pennsylvania, the system of sanitary control which has been developed or the prevention of the entrance of tuberculous cattle into the State, the repression of the disease by adaptation of the Bang method to herds in the State, the inauguration of a State meat inspection service which is the envy of sister States, the establishment of a State laboratory of the live-stock sanitary board and an experimental farm for detection of disease, and the discovery of new sanitary methods, the State of Pennsylvania has been a model to us all. When it is remembered that live-stock sanitary control work was inaugurated during the incumbency of the present State veterinarian in 1895, thirteen years ago, in the establishment of the live-stock sanitary board, we marvel how much can be accomplished in so short a time. Dr. Pearson asserts that animal tuberculosis in Pennsylvania is decreasing in prevalence, which is to be expected. Municipal meat inspectors, butchers, pathologists examining cattle after tests, the United States veterinary inspectors, all state that animal tuberculosis is being curbed in the State. Dr. Pearson is brave enough to say that this restriction of tuberculosis will lead, in time, to a stage in the repression when the disease will be of little public health or economic importance.

In Delaware, on the other hand, we find a situation the reverse of that in Pennsylvania, for animal tuberculosis is there neglected. The defects in the sanitary law are obvious. A thousand dollars per annum is all that is appropriated for live-stock sanitary work. There is no live-stock sanitary board and no State veterinarian provided for. The execution of the law is placed solely in the hands of the governor of the State. The provisions of the law are inexplicit. No reference is made to tuberculosis. No compensation is allowed for the destruction of tuberculous cattle. The law was written in the days before tuberculin was known, and has never been revised.

The State of Maryland is one of those examples, at present, of a commonwealth containing a live-stock sanitary board with much power for the control

of tuberculosis, a capable State veterinarian willing to combat the disease; but the effectiveness of the law is nullified by insufficient appropriation of money for administration. The State veterinarian declares that bovine tuberculosis is the most serious and wide-spread disease he has to contend with in the State, and statistics show that 20 per cent. of all cows slaughtered in the State in packing-houses are tuberculous. Yet no money is granted by the State for appraisal in case of the discovery of tuberculosis in herds, and there is no way legally to prevent the entrance of tubercular herds into the State.

In Virginia there is no such thing as warfare by the State against animal tuberculosis, as the energies of the State veterinarian and the Board of Control are wholly engaged in the fight against Texas fever, which is believed to be the greatest menace to the cattle industry there. However, if the experience of Maryland, the neighboring northerly State, indicates anything, it is that Virginia is probably also badly infected with tuberculosis. There is only one reference in the Virginia law to the disease: "That the disease known as tuberculosis shall be classed as a highly contagious and infectious disease, and such measures shall be taken by the board and its authorized veterinarian as to them may seem necessary to eradicate and prevent the spread of said disease." This sentence will not save Virginia from bovine tuberculosis.

No statistical reports are published by the State of West Virginia, and I have not been able to learn anything of the prevalence of the disease in that State. Under the law the commonwealth is, for sanitary control work, divided up into sections embracing, in each, several counties. One consulting veterinarian is designated for each section, whose duty it is to visit each herd of pure-bred cattle and each herd of dairy cattle once a year to inspect for infections, including tuberculosis, and, if necessary, to test them. In case of tubercular infection the animals are appraised by laymen, slaughtered, and paid for pro rata, by certificate, according to the amount of infection. There are grave omissions of sanitary points in this law as it works out in practice. For instance, there is insufficient police power given against the importation of infection.

The North Carolina live-stock sanitary law does not have anything to say about animal tuberculosis. It is, however, so worded as to cover all contagious diseases among domesticated animals. There being nothing in the law touching tuberculosis, the conclusion might seem to be warranted that no bovine tuberculosis existed in the State—which is preposterous. North Carolina does not appraise animals having a contagion; simply compels condemnation by regular authority. Dr. Tait Butler, the State veterinarian, incidentally reported at the meeting of the Interstate Association of Live-stock Sanitary Boards, held in Springfield, Ill., 1906, that he was accustomed to test cattle in the State for tuberculosis on request of owners,

stipulating that reacting animals be sent to a slaughter-house to be examined post mortem by him. All cattle showing lesions are condemned and buried.

In South Carolina the State veterinarian, in order to separate healthy from unhealthy animals, may make tuberculin tests of herds, either at the request of the owner or whenever two or more reputable citizens shall notify him of the existence of a contagion. In either case the expense of the tuberculin test must be borne by the owner. In case of reactions, those animals are condemned and destroyed without appraisal either by burying or burning. The regulations do not make compulsory the notification of the existence of tuberculosis by the owner of cattle. However, when the veterinarian acts in the case of an infection, it is a penal offense to interfere with his entrance to premises, or to refuse to disinfect buildings occupied by the tubercular cattle. Few cattle have been examined for the disease during the last year or two, but the veterinarian is of the opinion that the test should be applied to all commercial cattle used for dairying.

3. *Control Work Against Animal Tuberculosis in the Southern States.*—In the States toward the southern portion of the United States—Florida, Georgia, Alabama, Mississippi, Kentucky, Tennessee, Texas, Louisiana, Arkansas—where the climate varies from warm temperate to almost semi-tropical, we find conditions among the people the reverse of active, energetic, or ambitious to live up to the tenets of medical science. We observe poorness of sanitary law or absence of sanitary law, backwardness in control work, or such indifference or laziness that none is done or even thought of. On the other hand, in some cases we find States doing strenuous control work with creditable results. In every State there is need for work against tuberculosis, because the observations of veterinarians have detected the prevalence of the disease.

The first of the States, Florida, is in a deplorable condition as regards control work against animal tuberculosis. There is a ridiculously inconsequential section in the old law instituting a State board of health, providing for the suppression of contagious diseases of animals, particularly the domesticated animals. The officers of the board have sent me copies of the statute reports and letters acquainting me with the situation. The State board of health keeps in its service a veterinarian who investigates cases of infection reported to him. The calls that he has had show that bovine tuberculosis is rampant in the cities, like Tampa, calling for the test. However, there being no test requirements; no obligation to report disease; no provisions for the disposal of carcasses, the law is farcical.

Georgia is no better. Only as late as 1905 was provision made for a State veterinarian to be called in outbreaks of infections. The law of 1905, and that of 1899, are flimsy, primitive affairs, so short as to contain two or three general statements covering only a page or two of print. Under the law of

1905 the State veterinary surgeon is called in consultation, in case infection is reported, "by the ordinary of any county in this State, or upon application of the county commissioners in this State." The commissioner of agriculture writes me that live-stock sanitation is in its infancy, and that the State board of health has never issued anything on the subject. What an elysium for tuberculosis Georgia is!

Alabama has a most excellent live-stock sanitary law, passed March, 1907, by the efforts of Dr. C. A. Cary, the designated State veterinarian. The law is recent; but the regulations based on the power given in the law have been published and are now operative. They require: reporting of tuberculous cattle to the State veterinarian; killing of tuberculous cattle under the supervision of a city inspector, or at other places under the eye of the State veterinarian or of his assistant. The use of tuberculous cows in dairies is forbidden, and the importation of tuberculous cattle also, without the tuberculin test. Heavy penalty is set for breach of the law.

Little can be said of Mississippi. She has no live-stock sanitary laws touching tuberculosis; no live-stock sanitary board; no State veterinarian. Bills for live-stock sanitation have been introduced into the legislature every year for twelve years, without passing.

There is a statute relating to the control of infectious diseases of animals administered in Kentucky by the State board of health through the good offices of a State veterinarian, Dr. F. T. Eisenman, of Louisville. The law is weak; but the veterinarian is a duteous and daring man who lays hold fully of all power allowed him. The statute does not permit him to prevent the importation of tuberculosis of a bovine kind; nor restrict bovine tuberculosis in the State. But the veterinarian is constantly and valiantly reporting to the State board of health the state of things in the dairies of Kentucky, which are horribly infected with bovine tuberculosis. The horrors of animal tuberculosis in Kentucky may be illustrated as follows: An examination of the herd of the city almshouse of Louisville in 1906 showed a reaction of 56.8 per cent. Dr. Wyman's tests in Covington gave a much higher average percentage than this, and higher too than Shelbyville, which gave an average of 18.66 per cent. The State veterinarian feels assured that 30 per cent. of all cattle supplying milk to most cities of the State are tuberculous.

No control work against animal tuberculosis is done by the State authorities in Tennessee. The law provides for a live-stock inspector acting under the commissioner of agriculture, and county live-stock inspectors acting under the county boards of health, none of whom are veterinarians. The statute requires the reporting of existence of communicable diseases of animals and forbids the importation of animals with infectious diseases. But the report of the commissioner for 1906 is brief to the point of absurdity, and clearly indicates that nothing is being done except against Texas fever.

Texas has no law controlling animal tuberculosis. This State, which is as large as half a dozen of the larger countries of Europe and more, which has immense ranches and millions upon millions of cattle, is so backward in sanitary matters that it can afford to pay the pittance of $1200 per annum to a veterinarian to do its sanitary control work, who is a private practitioner giving what time to the State he thinks that he can afford. This man, Dr. W. G. Langley, informs me that, early in 1908, he tested with tuberculin over a thousand head of cattle, and found in some of the herds that the percentage of reactors was alarmingly high. He is trying to get a State appropriation for the testing of cattle without expense to the owners, but giving reimbursement for tuberculous cattle.

Tuberculosis is not deemed to be a very important part of the sanitary control work in Arkansas, though there seems to be no question, from recent investigations, that the disease is prevalent enough in the State. There is opportunity offered in the law passed in 1905 and 1907 for work against the disease by the veterinarian of the agricultural experiment station, Fayetteville, who has the work of the State in hand. His sanitary work at present is chiefly against Texas fever, though he deputizes veterinarians in case other infections make their appearance. The cities, notably Fort Smith and Little Rock (the capital), are taking up the matter of the sanitation of dairies and examination of cows for tuberculosis. Little Rock did so on the advice of Dr. Lenton, the State officer, who found 80 per cent. of infection in the cows supplying the State lunatic asylum and the blind and deaf-mute institutions.

In Louisiana that stout-hearted and strong-minded veterinarian, Dr. W. H. Dalrymple, reports that there is at present, sanitarily, chaos. The State board of health has the power to curb infections in domesticated animals, such as tuberculosis and anthrax, if it could get sufficient appropriations of money to do so. However, there are two bright spots in the sanitary outlook—the cities, such as Shreveport, Alexandria, and New Orleans, have good meat and milk inspection ordinances, including articles against tuberculosis. Dr. Dalrymple took occasion, recently, to recommend that the ordinance used by Shreveport be adopted by all the smaller municipalities in the State. The Louisiana board of health has advised the passage, by the legislature, of a food and drug bill, which it has composed, having meat and milk hygiene stipulations.

4. *Control Work Against Animal Tuberculosis in the Central States.*—The central States—Ohio, Indiana, Michigan, Illinois, Wisconsin, Minnesota, North and South Dakota, Kansas, Nebraska, Iowa, Missouri—contain a large share of the best farm lands and breed a large share of the best farm animals in the United States. Most of these States are notable for excellent live-stock sanitary laws, for live-stock sanitary boards which are composed of

liberal-minded men, many of whom are veterinarians, for scientific men in control who are keenly aware of the usefulness of the sanitary work and zealous in carrying it out for the amount of sanitary work done, for the kind of work done. Indeed, some of these States in these regards have been examples to the rest of the country. The bad features of the operation of sanitary law in this region are: the variance of the laws; there is no coöperation of these States as a group; there is sometimes a lack of scientific courtesy among the sister States in the operations of the laws.

Ohio has a splendid system of live-stock sanitation, which is, however, faulty in that not enough attention is paid to animal tuberculosis. Testing for the disease is permissive rather than mandatory. Still, when an owner agrees to have tests made by the State, he is obliged to kill and burn or sell for fertilizer all reacting animals and to disinfect premises most thoroughly. Numerous farmers in the neighborhood of municipalities are calling for the free test of their herds by the State, for the reason that these cities, of which Ohio has many, are demanding tubercle-free herds in the dairies.

Indiana live-stock sanitary law is brief and as free as possible from official machinery and red tape. By the State Board of Health is administered the food and drug law, which has meat and dairy articles drastic and severe. Indiana is sectioned off by the board of health, and to each section is assigned a food inspector, part of whose duty is to look out that the products of infected animals are not used in dairies. Inasmuch as the regulations of the live-stock sanitary law forbid tuberculous animals from being used in dairies, an opportunity is given the State veterinarian to get reports from food inspectors and to dispose of tuberculous animals under the law. These are held to be worthless, except for fertilizer; a nominal fee of two dollars being all that is allowed for them if condemned.

Michigan claims, probably not correctly, that over 80 per cent. of the other States have copied her sanitary law. However, its statute undoubtedly is a noble one, and it is obeyed, chiefly because of its heavy penalties and the known severity of Michigan justice. There is no appraisal for animals allowed when they are tuberculous, nothing being granted from the State funds for tuberculous animals. The live-stock sanitary commission claims that very little tuberculosis exists in the State. This is unquestionably erroneous, as the dairies which supply cities like Detroit probably contain much of the disease. The fault of the Michigan law is that too little scope is given the veterinarians and too much to laymen—the veterinarians are but the instruments of the commissioner. Veterinarians under it have too little initiative. The requirements in the Minnesota law for the persons who shall sit upon the board should be adopted in a revised Michigan law.

Illinois unquestionably has an average of 25 per cent. of all dairy animals infected with tuberculosis. Examinations of herds in State institutions

have given a still higher percentage. Yet the State has but few veterinary inspectors in its employ—only in Chicago and East St. Louis, I believe, where attempts are made to separate the sick animals from the healthy and to prevent their disposal within the State without State inspection. Illinois is greatly in need of a law giving this inspection at every point in the State where slaughter of animals takes place. Testing of animals for tuberculosis is not obligatory. No funds are provided to pay for infected animals when they are found as a result of the test.

The State of Wisconsin is carrying on a noble warfare against bovine tuberculosis at the instance of the live-stock sanitary board, the State veterinarian and the bacteriologist of the State College of Agriculture sitting on the board. Its law is one of the wisest cattle laws in the country. The details of the law need not detain us. Suffice it that ample power is allowed to prohibit importation of infected stock; to require notification of infection within the State; to force tests by State officers, condemnation of the tuberculous, and just appraisal. Wisconsin was the first to introduce the method of shipping reacting cattle to abattoirs to be examined post mortem by United States officers, at the option of the owner, the judgment of those officers being final. The owner in this case receives the net proceeds of the sale. In case he refuses to have such a herd shipped for slaughter and post-mortem, he must submit to having his herd held in quarantine as the State board may direct.

Minnesota is not one of those States which require the testing of cattle for tuberculosis, otherwise its sanitary officers are carrying on a notable and clear-headed fight against the disease. She is efficient in her work to prevent further importation of the disease, while requests for tests are increasing, owing to two important phases of the warfare—namely, her great cities, like Duluth, St. Paul, and Minneapolis, are forbidding milk to be sold from tuberculous dairies, and the State is encouraging testing by allowing a liberal award for condemned animals.

The year 1907 witnessed the passage of a law in North Dakota establishing a live-stock sanitary board, providing for a State veterinarian as executive officer, the veterinarian of the State Agricultural College for bacteriologist, and for assistant state veterinarians, all under ample pay. The regulations established require dairy and breeding cattle imported to show certificates of tuberculin test and compel testing of cattle within the State to be inaugurated in case of suspicion of tuberculosis. The State board in Bismarck, the capital, September, 1907, passed a resolution praying the United States Secretary of Agriculture "to establish such regulations as he may deem necessary to prevent the interstate shipment of tuberculous breeding and dairy cattle"—a remarkable petition.

Of Iowa it must be said that its sanitary leaders have adopted two pre-

cautionary sanitary measures against animal tuberculosis and have in mind another wise policy for the same purpose. Breeding and dairy cattle entering the State must show certificates of tuberculin test. Suspicious cattle are compulsorily tested. Every owner of a creamery, before delivering any skim milk to any person, must cause the same to be pasteurized at a temperature of 185° F. The State Board of Health recommends that all breeding and dairy cattle be tested with tuberculin at intervals of a year until herds are free from tuberculosis; that every dairyman and breeder be required to see that his purchases are free from tuberculosis, as ascertained by the tuberculin test. A definite, model milk and dairy ordinance has been printed and recommended for each town or village in the State.

Kansas does not require the reporting of cases supposedly tuberculous. Nor are there any appropriations of money for suppression of the disease. The control work against animal plagues, unfortunately for Kansas, is, under the law, placed in the hands of a live-stock sanitary commissioner, evidently a whilom farmer, who does his best, according to his restricted light, to control disease. Few cases of suspected tuberculosis are reported. When there are cases, the "department" furnishes the tuberculin and the tests are made either by a man delegated by the commissioner or by a man from the State Agricultural College.

There is a sentence in the Nebraska law preventing the importation of cattle or any domestic animals having infectious diseases; but the law is largely inoperative, as there is no provision for its enforcement by the legislature. Reporting of tuberculosis in cattle is not required, though, according to the last report of the deputy State veterinarian, notification of the presence of the disease was given by twenty-two counties. The State veterinarian is of the opinion that there should be a periodic test of all animals supplying milk to creameries in the State. The disease is rapidly increasing in the State in both cattle and hogs, according to the inquiries of the State University. There is no tuberculin test of cattle supplying cities, except Omaha.

Tuberculosis, the State reports say, is rapidly increasing in the State of Missouri. The State veterinarian writes: "There is already a sufficient number of tuberculous cattle in the beef and dairy herds of the State to guarantee the rapid spread of the disease in the future." Much power of quarantine is given the State board of agriculture, namely, to quarantine against any other State or territory; to quarantine any municipality in the State; to quarantine any barn, pen, store car, yard, or field, any of which are capable of infection. But no separate and definite specifications are made in the law against tuberculosis. The State dairy commissioner is advocating the passage of ordinances by all cities, requiring certificates of health for dairy cattle. Two cities, Carthage and Joplin, have done this. The State

veterinarian is advocating: first, a tuberculin test of all dairy cattle and indemnity for the tuberculous; that cities be empowered to provide ordinances for meat and milk inspection; that State inspectors be placed in the three State stockyards to prevent diseased cattle from being sold in the State.

5. *Control Work Against Animal Tuberculosis in the Rocky Mountain and Pacific States.*—Persons in the Rocky Mountain States who are interested in live-stock sanitation, as a rule, have found little response to appeals for legislation against animal tuberculosis. At all events, the sheep industry and the range cattle industry have so much engaged the attention of stockmen that questions bearing on the health of dairy cattle have been generally neglected. This is undoubtedly folly, as the State veterinarians are beginning to note the great prevalence of tuberculosis in many parts of those States, and are beginning to bewail the absence of sufficient sanitary law against the disease.

Colorado has been, for several decads, the Mecca for persons afflicted with tuberculosis. Yet animal tuberculosis in the State is only just now attracting any attention. The testing of cattle entering the State for tuberculosis is not required; nor is the test required for cattle supplying milk to Colorado cities and towns, with the exception of Fort Collins and a few others. A movement seems to be afoot to obligate dairymen to have all their cows tested and to keep them tubercle-free. The stock inspection commissioners have passed a regulation that all cattle tested and found to be tuberculous by veterinarians must be branded with a perpendicular mark three inches long on the forehead between the eyes. Colorado has a law and regulations governing the slaughter and inspection of animals in the State for food. Only one meat and slaughter-house inspector has been appointed, which will make the law largely inoperative.

Wyoming requires a certificate of health for breeding and dairy cattle to be imported into the State, showing that the cattle have successfully passed the tuberculin test at the hands of a responsible veterinarian. The live-stock law mentions specifically the kinds of diseases of animals for which indemnity is possible; but no reference is made to tuberculosis. Sanitary law is imperfect in Wyoming when compared with the more advanced States; though the present law in a general way gives sufficient power for the control of contagions among animals.

From a live-stock standpoint one of the most interesting States in the whole west is Montana. Almost all the towns therein, of over five thousand inhabitants, have milk and meat inspection ordinances, requiring the services of a skilled veterinarian for their administration, which will go a long way to help control of animal tuberculosis. Breeding and dairy cattle must show certificates of tuberculin test before entrance to the State is allowed. The tuberculin test is given on request to all cattle from sections of the common-

wealth; though, unfortunately, from lack of appropriation, during the last year or two not all of these requests have been granted. No indemnity is allowed in Montana for animals found tuberculous; though option is given the owner, either to furnish bond that he will pursue the Bang method for control of the disease in his herd, or, the animals being slaughtered, all carcasses, except those showing very minor lesions, must be buried or burned. There also must be strict stable disinfection.

Utah has no State veterinarian; no live-stock sanitary board concerned with bovine tuberculosis; no State sanitary law controlling the disease. It is prevalent, however, as attested by the veterinarian of the State experiment station, who, on request of local boards of health, has made tests and condemned animals for the disease during the last two years.

The major portion of the time of Idaho stockmen is given to sheep. The State veterinarian feels sure that there is hardly any bovine tuberculosis in the State. The law has only been in operation since 1905. Any animal found affected with an incurable disease is deemed to have no property value and no indemnity is allowed. The meat, milk, and skin of animals having an incurable disease must not be sold or otherwise disposed of under penalty. There is a prohibition of importation of affected stock.

Animal tuberculosis is given the most important place in the law of Washington, when it is written: "He [the State veterinarian] shall have general supervision of all contagious and infectious diseases among domestic animals within or that may be in transit through this State, and he is authorized and empowered to *inspect and test* all cattle within the State for tuberculosis." All cattle brought into the State, over six months of age, for breeding and dairy purposes, must have presented with them a certificate attesting their freedom from tuberculosis. It is the disease most frequently found in the cattle of Washington.

Live-stock sanitation could hardly be worse than it is in Oregon. Correspondence with the governor, and with his appointee to do the State work, elicits the fact that the work is all well nigh in abeyance.

The question of live-stock sanitation in Nevada is something of a joke. The State is devoted to mining. The population is very sparse. The agricultural interests are confined to one small corner of the commonwealth. An act was passed in 1905 appointing a State veterinarian and defining his duties. Under the law, whenever tuberculosis is discovered on any farm, the owner must submit to the regulations imposed by the State officer. Condemned tuberculous animals must be burned or buried. But, as there is no penalty imposed, and as the State veterinarian has never printed a report, so the Secretary of State tells me, of any findings, the statute must not be taken too seriously. Farming in Nevada is nearly confined to sheep-raising, and sheep are seldom tuberculous.

In California live-stock sanitary work is admirably conducted, though, as pointed out by the State veterinarian, there are many defects in the law. Tuberculosis is acknowledged to be very prevalent on many dairy farms in the State, yet the department has made no systematic effort, as such, to combat it, owing to the fact there have been no appropriations for the work. By the efforts of Dr. Keane, the State officer, California passed a law in 1897 permitting the passage of ordinances by the counties to establish, through the boards of supervisors, county live-stock inspectorships for the prevention of disease of live-stock and the supervising of the work of creameries. Many counties have undertaken the work, which has aided much in the control of tuberculosis and other infections. San Diego has such an ordinance, requiring, among other things, absence of tuberculosis from dairy animals.

6. *Control of Animal Tuberculosis in the Southwest of the United States.*—The laws of the southwestern States and territories are not essentially different from the statutes of other States further north. The expectation would be that, as this region is the El Dorado of tuberculous patients, no bovine tuberculosis would be found in this region. Yet reports from the region point out the existence of animal tuberculosis here as elsewhere. There is no part of these United States where animal tuberculosis does not exist, no climate free from it at present.

Oklahoma's efforts are, on the face of the reports, directed against Texas fever rather than against diseases like tuberculosis. Under the law, the live-stock sanitary commission parcels up the State between three veterinary live-stock inspectors (or rather such seems to be the import of the law) who are accountable for the sanitation of the region, both to keep infection out and to suppress it within the district. They can deputize persons to examine animals intended for slaughter within the region and rule on the disposal of the condemned. Probably little is done against tuberculosis.

The territory of New Mexico has an excellent code of sanitary laws administered by a body of laymen called the cattle sanitary commission, who employ a veterinarian, under the law, to take charge of the sanitation. Strict regulations are in force pertaining to importation, movement of cattle within the territory, suppression of contagion when it exists, indemnity, and disposal of carcasses. A tuberculin test is required before cattle can enter the territory. If a certificate is not shown at entrance, a test of cattle is made at the owner's risk and at his expense. Tuberculosis is one of the two diseases specifically mentioned in the sanitary law, hence it must be of importance in the territory. No indemnity is paid for cattle tubercular when brought into the territory, though these cattle are condemned and destroyed. Albuquerque, the capital, has a strict milk and meat ordinance against tuberculosis, and Las Vegas will presently follow the lead of the capital city.

It is with pleasure that I report the state of sanitary affairs in Arizona. That territory is, and may well be, proud of its attainments in live-stock sanitation. It has a body of live-stock sanitary laws which are stringently enforced, covering every necessary point in modern sanitation of animals. The board is enlightened and hearkens to the voice of that public-spirited man and most capable veterinarian, Dr. J. C. Norton, of Phœnix. From Maricopa County, which is by far the largest county,—indeed, the only county where the cattle industry is of much account,—tuberculosis was entirely eradicated at great expense in 1894 and 1895, and tuberculosis has caused no losses during the last two years. One of the main reasons for the success is that the disease was eradicated when its area was very limited—a lesson to sister States and territories, where large sums of money are expended annually because of neglect of tuberculosis. No doubt one of the reasons for the success of the territorial live-stock sanitation is that the territory is very liberal to the members of the board and the territorial veterinarian. In addition to his salary, which seems ample, under the circumstances, the veterinarian is allowed under the law ten cents for every mile he travels while on duty.

VII. Critique of Conditions and Some Suggestions for Their Amelioration.

The conditions, as regards tuberculosis among domesticated animals in the United States, are nearly those of anarchy—each State and territory doing what seems good in its own eyes, or doing nothing, as the case may be.

The explanations for these anarchical conditions are as follows:

1. The country is a new one and agricultural conditions are still unsettled in the extreme.

2. Sanitary law is but a thing of yesterday. Sanitary laws of any consequence or usefulness against contagious or infectious diseases were nearly unknown before 1884, when the great European scourge, pleuro-pneumonia, broke out in this country. Following the creation of the United States agency against animal infections—the Bureau of Animal Industry—came the initiation of live-stock sanitary law in the individual States.

3. Many of the live-stock sanitary laws are imperfect or untried. In sanitary practice grave omissions are revealing themselves in these documents.

4. Many States have primitive live-stock statutes covering tuberculosis. Others have no statute covering the disease; or, still worse, statutes which, because they are contrary to the State constitutions, or because they carry with them no appropriations of money to keep up the work or to begin it, or have no penalty which can be legally imposed or which is insufficient, are inoperative.

5. Some of the States which have no statute are unaware that bovine tuberculosis is spreading rapidly in them. They remain so until an accident, perhaps,—for example, examination of herds belonging to the State government,—reveals the alarming extent of the disease.

6. Many of the States which have excellent statutes have not full and absolutely reliable information on the exact amount of the infection. No State has thoroughly searched out, and accurately mapped out, the amount of tuberculosis present in it.

7. There has never been a thoroughgoing popularization of the simple and easily understood facts about tuberculosis among domesticated animals, as has been done in parts of Europe.

8. The States have taken up the task of combating tuberculosis single-handed and have so gone on from year to year; whereas, so grave tubercular infections as have manifested themselves would require conferences of sanitary authorities in neighboring States on the disease and the crusade against it.

9. The joining together, voluntarily, of the live-stock sanitary officers of the different States into a permanent association for counsel is a thing of but a few years' growth. This association, called "The Interstate Association of Live-stock Sanitary Boards," has, as a nucleus, members from only a few States. Being consultative, advisory, and voluntary only, and being at present an embryonic organization for sanitary counsel, it has never been able to take up the question of tuberculosis with satisfactory poignancy and authority.

10. The question of warfare against tuberculosis of the domesticated animals has never been made a matter of national conference. Nor has the united power of the individual States and the United States been pitted against it, as has been done in the case of pleuropneumonia, foot-and-mouth disease, and Texas fever.

Suggestions for the Amelioration of these Conditions.

1. The veterinary organizations, the State or territorial veterinary officers, and other influential veterinarians who are informed on local needs or conditions, should enlighten the people by every means possible on defects in the sanitary law, and should not scruple to copy the main features of the best live-stock sanitary laws, such as Michigan, Wisconsin, Pennsylvania, Minnestoa, or Arizona, to the end that model laws against tuberculosis may be in operation.

2. The existence or absence of tuberculosis among domesticated animals in each State or territory should be gaged by veterinary graduates and its extent determined by the State authorities. Maps should be made showing the topography of animal tuberculosis in each State. Dr. Mohler made,

provisionally, such a map for the United States showing the worst points of infection, and Dr. A. T. Peters has done the same thing for Nebraska. We should know where the enemy is and how great his strength before we can carry on a successful warfare.

3. Brochures should be written giving the simple and easily understood facts about bovine tuberculosis, in a few hundred words, expressly for breeders and animal husbandmen generally. These, by common agreement between the United States authorities and the authorities of the individual States, should be given the widest publicity in all the currents of the press and the widest circulation as pamphlets. Technical jargon will not do in such brochures. The papers must be terse, concise, simple.

4. The State live-stock sanitary authorities, lay and veterinary, in each State and territory, should, by might and main, be induced to enter into the work of the Interstate Association of Live-stock Sanitary Boards. This Association, when so enlarged, or when the majority of such authorities are represented, should take up earnestly the question of animal tuberculosis as a national question, vital to each State and territory, and urge, in every practical manner possible, serious and speedy work against it.

5. The National Association for the Study and Prevention of Tuberculosis under the auspices of which this year the International Congress on Tuberculosis meets, should have a permanent section on tuberculosis of animals and its relations to man, the members of which should be, as far as possible, the national and State veterinary authorities and all others interested in animal tuberculosis as a national problem. This adjunct section could do much to centralize and unify endeavor against tuberculosis of the domesticated animals.

6. The time is ripe for a first conference of the national veterinary authorities of the United States and the State veterinary authorities of the individual States and territories, to consider and advise on the whole problem of tuberculosis of animals on the American continent. Mexico and Canada should send national and provincial representatives to confer upon international phases of the infection. These conferences should be upon the legislative, economic, and sanitary sides of the problem, and should be eminently calm and wise. At such a conference such questions as that of the prevention of interstate trade in tubercular animals and the like may be mooted. The first conference should be followed by others, either bienially or trienially, all to be fully reported.

VIII. What May be Done in the Future in the United States of North America Against Tuberculosis of the Domesticated Animals.

At present sanitarians of North America are convinced that the preponderance of evidence points to the capability of the transmission of bovine

tuberculosis to man. The chances are so great that precautionary sanitary legislation, following the resolutions of several International Congresses on Tuberculosis, has, in the individual States composing the United States, been passed against the disease in the domesticated animals. The course legislation and governmental control will take in the future will depend on whether approximate unanimity can be reached on the question of intertransmissibility of bovine and human tuberculosis. Even if it should be finally determined that the possibility of the transmission of bovine tuberculosis to man is very slight, or naught, we have overwhelming evidence of the intertransmissibility of bovine tuberculosis among the other domesticated animals. This, in itself, will continue to engage the attention of legislatures and lead to the perfecting of live-stock sanitary law as a precautionary means.

Whether there is danger of transmission of bovine tuberculosis to man or not, the American people are unalterably against the use of badly infected carcasses for food or the milk of tubercular animals for food. This also causes the enaction of sanitary law. For sanitary, as well as economic reasons, therefore, live-stock sanitary law is bound to be more perfected.

As the disease, tuberculosis, is far more ruinous to live-stock than pleuropneumonia of cattle, which was controlled in America and stamped out, so we will eventually proceed against tuberculosis through the United States government agencies and the agencies of the governments of the individual States included in the United States as we did against pleuropneumonia. It was the alarm among the American people caused by the peril to the live-stock industry from pleuropneumonia which originated a large share of our present live-stock sanitary laws. The peril of tuberculosis, when well understood, will bring into being laws and will rejuvenate or perfect old ones.

The American people have inherited the legal and governmental genius of the Teutonic race. In the composition of live-stock sanitary law they have had to adapt themselves very rapidly to the new agricultural conditions of the western world. The people of the United States have displayed invention in statutory law, legal originality sufficient to meet all public needs. They will make no failure, eventually, in the matter of live-stock sanitary law for the successful control of tuberculosis of the domesticated animals. The control of animal tuberculosis over a whole continent is a colossal problem; but mutual coöperation of the States in the movement, uniformity of plan, and a common agreement having been obtained by periodic, national conferences of live-stock sanitary officers, the systematic work resulting therefrom ought to make us successful combatants against the disease in domesticated animals.

Vorbeugende gesundheitliche Gesetzgebung gegen die Tuberkulose der Haustiere in den Vereinigten Staaten.—(HUGHES.)

In Amerika herrscht eine allgemeine Uneinigkeit bezüglich der Ansichten Koch's, welche die Gefahr der Tiertuberkulose den Menschen gegenüber verkleinert, und welche das Resultat von Resolutionen früherer internationaler Kongresse, die Durchführung eines grossen Teiles vorbeugender Gesundheitsgesetzgebung gegen Tuberkulose der Haustiere in den einzelnen Staaten, aus denen sich die Vereinigten Staaten zusammensetzen, zur Folge gehabt hat. Die Herausbringung und Durchführung dieser vorbeugenden Gesundheitsgesetzgebung war von vielen Schwierigkeiten begleitet, die hauptsächlich in der Neuheit des Landes, Ungewissheit über die Ausdehnung der Infektion und Mangel an einmütiger Arbeit der tierärztlichen Beamten in den verschiedenen Staaten, die bei der Fehde in Betracht kommen, ihren Grund haben. Bei Betrachtung der Frage des Kampfes gegen Tiertuberkulose in den einzelnen, in den Vereinigten Staaten eingeschlossenen Staaten, vom Standpunkte der Gesundheitsgesetze, und deren Anwendung müssen die folgenden Bedingungen wahrgenommen werden.

1. Tierärztliche Gesundheitsgesetzgebung gegen Tuberkulose der Haustiere ist vergleichsweise eine Neuheit in den Vereinigten Staaten.

2. Viele der Gesundheitsgesetze zur Erhaltung des Lebens sind sehr unvollständig oder in der Handhabung unversucht.

3. Viele Staaten haben primitive, andere gar keine Lebenserhaltungs-Gesetze, noch andere haben kein Geld vorgesehen, um die Gesetze, die sie haben, durchzuführen.

4. Viele Staaten sind sich der Ausdehnung und des Überwiegens der Krankheit nicht bewusst; andere wissen überhaupt nicht, dass sie existieren.

5. Es ist niemals auf Grund einer grossen fortschreitenden Aktion die Kenntnis der einfachen Tatsachen über Tiertuberkulose unter den Massen verbreitet worden.

6. Die Staaten haben den Kriegszug gegen die Tiertuberkulose auf eigene Faust anstatt auf Grund einmütigen Zusammengehens unternommen.

7. Der Versuch, alle Gesundheitsbeamten in einer einzelnen Vereinigung zu gemeinsamer Beratung und Aktion gegen Infektionen wie Tuberkulose zusammenzubringen, ist bis jetzt nur von einigen wenigen Staaten unternommen worden.

8. Die Frage des Kriegszuges gegen die Krankheit ist nie ein Gegenstand nationaler Beratung aller interessierten Beamten der Bundesregierung, der Staaten und der Städte gewesen.

Für die Verbesserung dieser Bedingungen sind die folgenden Punkte in Betracht zu ziehen:

1. Die Bevölkerung der einzelnen Staaten sollte auf die Mängel in den

Gesundheitsgesetzen aufgeklärt werden durch tierärztliche Organisationen, Beamte und einflussreiche praktische Tierärzte. Die besseren Gesundheitsgesetze sollten von den Staaten, welche ungenügende haben, nachgeahmt werden.

2. Die staatlichen Autoritäten sollten die Ausdehnung der Tiertuberkulose innerhalb ihrer Grenzen ausmessen.

3. Erzieherische Blätter und Broschüren sollten geschrieben werden, um das Volk über das Überwiegen und den Ernst der Krankheit zu informieren.

4. Die tierärztlichen Autoritäten aller Staaten sollten sich zu einer gemeinsamen Organisation gegen die Krankheit vereinigen.

5. Die nationale Vereinigung für das Studium und die Verhütung der Tuberkulose sollte eine ständige Abteilung haben, die sich mit der Tiertuberkulose und ihren Beziehungen zum Menschen beschäftigt.

6. Es sollten augenblicklich in einer kontinentalen Konferenz über Tuberkulose die Delegaten der Vereinigten Staaten, Mexikos, und Canadas zusammentreten. Wenn diese Vorschläge gehandhabt werden, würde Übereinstimmung in tierärztlicher Gesetzgebung in den einzelnen Staaten gegen Tiertuberkulose das triumphierende Resultat sein.

Législation sanitaire préventive contre la Tuberculose des Animaux domestiques aux États-Unis.—(Hughes.)

En Amérique, on ne partage guère les vues de Koch sur la transmission par l'animal à l'homme de la tuberculose: aussi, se conformant aux résolutions votées par lés précédents Congrès internationaux, plusieurs des États composant les États-Unis ont-ils promulgué un certain nombre de lois sanitaires préventives contre la tuberculose des animaux domestiques.

Cependant le passage et l'application de ces lois ont rencontré bien des difficultés dues principalemente à la jeunesse du pays, à l'incertitude où il semble être de l'étendue de l'infection, et à l'absence de coöperation de la part des officiers vétérinaires dans les nombreux États qu'intéresse la lutte contre la tuberculose.

Si l'on considère la lutte contre la tuberculose animale aux États-Unis par rapport aux lois sanitaires et à l'administration, on remarquera les conditions suivantes:

1. La loi sanitaire vétérinaire contre la tuberculose des animaux domestiques est, relativement, une nouveauté aux États-Unis.

2. Beaucoup des lois sanitaires concernant le bétail sont très imparfaites ou bien n'ont pas été appliquées.

3. Beaucoup d'États ont une législation du bétail trop primitive; d'autres

n'en ont aucune; d'autres encore n'ont pu voter aucune subvention pour la mise en exécution des lois qu'ils possèdent.

4. Beaucoup d'États ne se rendent pas compte de l'étendue des ravages de la tuberculose; d'autres semblent même ignorer qu'elle existe.

5. Il n'y a jamais eu, dans les masses, une vulgarisation assez étendue des simples faits de la question de la tuberculose animale.

6. Les États n'ont pas entrepris la guerre contre la tuberculose animale conjointement, mais individuellement.

7. Très peu d'États onts encouragé les efforts tentés pour réunir les officiers sanitaires du bétail en une seule association, dans le but d'échanger des idées et de faire cause commune contre des infections telles que la tuberculose.

8. La question de la lutte contre cette maladie n'a jamais été le sujet d'une conférence nationale de tous les officiers intéressés, dans la nation, les États et les municipalités.

Il est plusieurs remèdes à ces diverses conditions:

1. Les sociétés vétérinaires, les officiers de santé, les médicins vétérinaires influents devraient éclairer les populations des divers États sur les défauts de leurs lois sanitaires. Les États mal servis sous ce rapport devraient copier les lois des États mieux pourvus.

2. Chaque État devrait mesurer officiellement l'étendue des ravages de la tuberculose animale sur son territoire.

3. On devrait publier et distribuer des fascicules, des brochures, pour révéler aux populations la fréquence et la gravité de la maladie.

4. Les autorités vétérinaires de tous les États devraient former une grande association contre le fléau.

5. L'association nationale pour l'étude et l'extinction de la tuberculose devrait avoir une section permanente s'occupant de la tuberculose animale et de ses rapports avec l'homme.

6. On devrait réunir immédiatement un congrès continental de la tuberculose animale, où les États-Unis, le Canada et le Mexique enverraient leurs délégués.

Si les suggestions précédentes étaient suivies, on obtiendrait un résultat magnifique, l'unité, dans tous les États, de la législation vétérinaire contre la tuberculose animale.

SURVIE ECONOMIQUE DES BOVIDES AYANT REAGI A LA TUBERCULINE.

By J. B. Piot (Bey),
Cairo, Egypt.

Dans un but à la fois scientifique et économique, j'eus, en 1899, l'idée de m'enquérir de la proportion de bovidés tuberculeux qui pouvaient exister sur le bétail de l'Administration des Domaines de l'Etat égyptien. Et comme ce bétail était constitué, à ce moment, par environ 4000 bovidés adultes, répartis dans une soixantaine de fermes du Delta nilotique, la proportion trouvée sur le bétail domanial devait du même coup représenter assez exactement celle de l'Egypte entière. Tant au point de vue des conditions hygiéniques que de l'âge et de l'état du bétail, les fermes domaniales ne présentant que fort peu de différences, je choisis au hazard, pour ces essais, la ferme de Chendalat, province de Gharbieh, comprenant 47 bovidés, agés de 5 à 17 ans, de race ménoufi, tous utilisés aux divers travaux de la culture, et j'inoculai tous ces animaux, en 2 lots, les 21 et 24 septembre 1899, avec la tuberculine de l'Institût Pasteur de Paris.

Sur ce nombre de 47 boeufs, 39 présentèrent la réaction caractéristique; 8 restèrent insensibles à l'injection. C'est donc une énorme proportion de 83% de sujets tuberculeux, constatée sur un groupe d'animaux qui représente très sensiblement la moyenne du bétail égyptien.

Parmi les 8 individus qui n'ont pas réagi à la tuberculine, on compte *un* boeuf agé de 5 ans, 4 de 6 ans, 1 de 8 ans, 1 de 11 ans, et 1 de 13 ans. On voit ainsi qu'à partir de l'agé de 7 ans, les sujets non tuberculeux ne constituent plus qu'une très minime exception.

Donc, au double point de vue où je m'étais placé pour cet essai, les résultats ne manquent pas de présenter un très réel intérêt, et pour ma part, je les considère comme absolument incontestables, parce que j'ai constamment trouvé des lésions tuberculeuses sur les sujets morts ou abattus, plusieurs mois, plusieurs années après la réaction à la tuberculine. Ces résultats ne font d'ailleurs que confirmer la valeur diagnostique de la tuberculine, lorsque l'opérateur se place dans les conditions indiquées par Bang, Nocard, Arloing, et que le Dr. Calmette rappelait magistralement, hier encore, à la 3 *e* Section de ce Congrès.

Ayant pu suivre les 39 animaux qui avaient réagi à la tuberculine jusqu'à leur mort ou leur mise en réforme, j'ai cru devoir vous apporter ici le résultat de mes observations.

En dehors de l'intérêt scientifique qu'elles peuvent présenter et qu'atteste le Dr. Calmette, elles me paraissent offrir un intérêt économique qui a bien sa valeur, en Egypte tout au moins, car les bovidés y sont utilisés pour le travail jusqu'à complète incapacité, c'est à dire jusqu'à l'âge de 20 et même de 25 ans.

Les 39 boeufs décelés tuberculeux par la réaction à la tuberculine se répartissaient ainsi au point de vue de l'âge:

3 de 5 ans
4 de 6 ans
6 de 7 ans
4 de 8 ans
2 de 9 ans
3 de { 11 ans, 12 ans, 13 ans, 14 ans }
4 de 15 ans
1 de 16 ans
2 de 17 ans
et 1 de 18 ans

Sur ce nombre, il existe encore 9 animaux vivants et aptes au travail, dont 1 de 14 ans et 2 de 8, de 7, de 6 et de 5 ans, cet âge etant calculé au moment de l'inoculation à la tuberculine.

Sur les 30 autres animaux

1 boeuf de 18 ans a fait encore une année de service
1 de 17
4 de 15
1 de 14
1 de 12
1 de 11
1 de 8 ont travaillé également pendant toute une année.

1 de 16 ans a continué de travailler pendant 2 ans
1 de 14
2 de 15
1 de 12
1 de 11
2 de 9 ont travaillé pendant ce même temps.

1 boeuf de 17 ans peut travailler encore pendant 3 ans
1 de 13

1 de 12
1 de 11
et 2 de 7 peuvent travailler pendant 3 ans.

Un boeuf de 14 ans est resté en service pendant encore 5 ans

2 de 7 ans
2 de 6 ans sont resté en service pendant 5 ans.

Et enfin un boeuf de 18 ans a fourni encore 6 ans de service, ainsi qu'un boeuf de 9 ans.

Ces 30 animaux ont été successivement rayés de l'effectif, d'une part à l'époque de la réforme générale qui a lieu chaque année au mois de mai pour cause d'incapacité au travail due, soit à l'usure de l'organisme, soit à des tares physiques, soit à des maladies sporadiques, soit enfin à la tuberculose, et d'autre part, par la vente ou l'abatage au cours de l'année pour cause de tuberculose aiguë ou de tout autre accident rendant l'animal inutilisable.

J'ai pu assister à l'abatage d'une dizaine de ces animaux et m'assurer ainsi que tous présentaient des lésions plus ou moins étendues de tuberculose.

Il va sans dire que les sujets qui ont survécu une ou plusieurs années à l'injection de tuberculine, et, à fortiori ceux qui sont encore vivants à l'heure actuelle, ne présentaient pas de lésions ouvertes de tuberculose. J'ai pu m'assurer de ce fait à l'autopsie de quelques uns d'entre eux, abattus pour fractures ou pericardites traumatiques. Les lésions tuberculeuses se trouvaient localisées dans les ganglions rétro-pharyngiens, dans ceux de l'entrée de la poitrine, du mediastin ou du mésentère, ou dans le foie et le poumon sous la forme d'abcès plus ou moins volumineux, et généralement calcifiés. De l'exposé sommaire de cette expérience, laissez-moi tirer les conclusions suivantes:

En premier lieu j'y trouve la justification absolue de la méthode de mon excellent ami, M. le Professeur Bang, de Copenhague, dans la lutte préventive contre la tuberculose.

Si l'abatage immédiat des sujets tuberculeux à lésions ouvertes s'impose tant pour éviter un dépérissement et une dépréciation de l'animal au point de vue de la viande, que pour empêcher la contamination par les matières expectorées ou rejetées, il peut y avoir, et il y a certainement un avantage considérable à conserver dans l'isolement les animaux qui ont réagi, tant pour ceux destinés à l'engraissement que pour les animaux de travail.

En second lieu, la survie plus ou moins longue et assez souvent même considérable des sujets qui ont réagi a la tuberculine, permet de poursuivre sur ces animaux des expériences de curabilité de la tuberculose, soit par des injections successives du tuberculine, soit par tout autre moyen que la science ne tardera sans doute pas à decouvrir.

MEAT AND DAIRY HERD INSPECTION AS PREVENTIVE MEASURES AGAINST THE SPREAD OF TUBERCULOSIS AMONG CATTLE.

By Dr. Otto G. Noack,
Reading, Pa.

Measures for the protection of man against the infection of "animal tuberculosis are indispensable" was the conclusion reached by Damman and Muessemeier at the end of their research work on the relationship of human and bovine tuberculosis.

This statement is important, not because with it they assert the identity of the tubercle bacilli causing disease in the human and in the bovine race, in opposition to Koch's doctrine that tuberculosis of man and animal are two distinct diseases, not communicable from one to the other, but because it is the official acknowledgment of the prevailing theory of the uniformity of the tubercle bacilli, as this investigation was made at the instigation of the Royal Prussian Department of Agriculture. Besides Damman and Muessemeier, or rather prior to these investigators, Von Behring, Arloing, Preisz, DeJong, Salmon, and many others had proved the inaccuracy of Koch's assertion, and the International Veterinary Congress at Budapest, 1905, adopted the following resolution: "The suppression of bovine tuberculosis is absolutely necessary, not only in regard to economy, to lessen the damage caused by this scourge, but also to prevent the danger of transmission to man." The second report of the English Commission on Tuberculosis, 1907, reiterates likewise: "Man and beast can infect each other."

Since the uniformity of tuberculosis, therefore, is proved beyond a doubt, it remains for the proper authorities to take steps to introduce measures which will restrict, and possibly prevent, any infection of man from tuberculosis existing among animals. All such measures naturally will have a tendency to affect the transmission of disease from animal to animal, because every hygienic regulation is directed to this effect, to diminish and destroy the sources of contagion.

The most effective hygienic measures in this direction are meat and dairy herd inspection, which are practised for the benefit of man, but at the same time, if properly enforced, will restrict the spread of tuberculosis among cattle.

The slaughter-houses, especially where no control by local authorities has been exercised, have been centers of infection and distribution of diseases, especially tuberculosis, because it will happen to every butcher that, in the course of time, he may kill an animal more or less so afflicted. In many instances the tubercular material has been fed to hogs, and, as experience has proved, they contracted the disease; or rats, which are the constant inhabitants of such places, spread the disease through the neighborhood, in helping to dispose of the tubercular material, which they carried into the corn-cribs of the farmer and troughs of his cattle.

How bad the conditions in such slaughter-houses are may be easily recognized from a few cases, which I shall refer to and which were revealed by the State Meat Inspection Service of Pennsylvania. On the premises of a slaughter-house, in the northwestern part of the State, forty-eight hogs were kept, of which thirty-seven were so badly afflicted with tuberculosis that most of them were found to be unfit for human food. In another slaughter-house, in the central part of the State, six hogs were quarantined, of which two were killed showing tuberculosis, while the other four died of the disease during the following three months.

Furthermore, knives, other utensils, and floors never were disinfected or cleansed properly, and, therefore, became regular hot-beds for the growth of the bacilli of tuberculosis. Such conditions were changed immediately wherever a system of meat inspection has been introduced, because cleanliness and sanitary conditions and the proper disposal or destruction of offal, especially from diseased animals, were the first things to be looked after; although in the United States we hardly can speak of a complete or perfect system of meat inspection, with the exception of the Federal Meat Inspection Service, as far as it relates to interstate trade, and the municipal meat inspection at Nashville, Tennessee. Here I shall not forget to mention the newly instituted meat inspection system of the State of Pennsylvania—the only system at this time in this country, very defective yet, but far-reaching in its results under the direction of the secretary of the State Livestock Sanitary Board. With pride, as a citizen of this commonwealth, I may say that 90 per cent. of the slaughter-houses within the borders of this State, no matter whether located on a mountain-ridge or in a remote corner of some valley, can favorably be compared at this time and compete with any small slaughter-house of any State or nation as to cleanliness and sanitation.

Compelling the butchers to keep their places in sanitary condition, therefore, means the destruction of many sources of tubercular infection. Meat inspection can be made very effective and great results may be obtained, not only by keeping killing establishments clean and sanitary, but by tracing the animal to the place from where it was shipped, whenever a carcass

is found to be afflicted with tuberculosis. In this way we shall be enabled to discover the location, and probably the source of infection for the place in question.

If the commission man or farmer could be educated or compelled to mark his animals with a number or sign, burned on the shoulder or hip of the animal before it leaves the farm, tracing of animals would be comparatively easy.

The recommendation of the Bureau of Animal Industry as to numbered tags I do not think advisable, because the tags are torn from the ear very easily, and many of the animals would lose them before reaching the point of destination. In those cases it would be impossible to identify the animal.

Until we arrive at this point, a great deal of educational work among the farmers will have to be done. It will be a matter for the State authorities to take up, sending bulletins with such information to the farmers throughout the country, that they may more readily comprehend the situation, and realize that their assistance in the eradication of tuberculosis is for their own personal benefit.

If a system of this kind is established, it will be an easy matter to get at the root of the evil. I shall show from the following example what may be done in this direction: At a sanatorium it was found that the organs and viscera of most of the hogs killed appeared to be in such an abnormal condition that even the men who did the killing thought the hogs were afflicted with some disease, which upon bacteriological examination was recognized as tuberculosis. After close inquiry as to feeding, the cause was traced to the skimmed milk, which was given daily in a raw state as food to the hogs. On account of the prevalence of tuberculosis on the premises the herd of sixty-five head, consisting mostly of Holsteins, was tested with tuberculin, and fifty-six were found to be tubercular—forty-seven on the first, nine on the second test. They were slaughtered and disposed of according to the rules of the meat inspection service. Afterward only tested animals were purchased and added to the herd, and as a precaution milk was pasteurized and then fed to the hogs. Since, no cases of tuberculosis in hogs have been discovered at this place.

In Pennsylvania the State Live-stock Sanitary Board has practically a system of locating farms infested with tuberculosis. In 1903 the legislature passed an act, known as the "Butcher's Indemnity Act," to encourage the repression of tuberculosis of cattle, and to provide for the disposition of the carcasses of meat-producing animals that are affected with tuberculosis to a degree that renders their flesh unfit for use as food.

Whenever the butcher or farmer claims indemnity for a diseased carcass, he has to prove, after a proper autopsy by a veterinarian, and by affidavits of the previous owner or owners, that the animal has been for four months

prior to slaughtering in the State of Pennsylvania. By so doing the State Live-stock Sanitary Board receives knowledge where the tubercular animal had been, and even where it was raised. In some cases an examination of such herds is made to learn to what extent tuberculosis is prevailing, especially if a dairy farm is involved. Advantage to the fullest extent is not taken of this law at the present time, on account of incurring popular disfavor, but as the education of the people on this subject progresses and the value of such examinations is understood, the law will be more strictly enforced. For example, I shall show, from the farmer's attitude toward the tuberculin test, what education does. Ten years ago bitter opposition was made against the examination of cattle with tuberculin, and the applications made for such tests at State expense were few; they number now nearly one thousand annually, besides the private tests which are made continually and aggregate more than one hundred. One setback is given this work, due to the small appropriations by the legislature, which are always exhausted long before the next may be used.

Since Chauveau has proved that tubercular germs contained in food cause tubercular lesions in the intestinal tract, meat inspection ought to be made thorough in order to eradicate tuberculosis among cattle, because it is one of the most efficient means to obtain the desired results.

Through meat inspection we are led to the dairy farm—the source of spreading tubercular infection. Meat is the food of the adult; but of the young and newly born mammals it is milk, and nothing else can replace it. From a hygienic point of view it is necessary to demand that the milk come from healthy cows, is handled in a cleanly manner, and is properly cared for.

The dairy herd inspection, accordingly, will have for its object the proper lighting, ventilation, and sanitation of stables, the different methods of diagnosing tuberculosis, and the methods of protection against the acquisition of the disease.

No matter in what condition the stable is, so long as there is no disease existing in the stable, no danger of tuberculosis will arise for man or beast; but the aspect changes entirely if the dreaded disease is present. Danger lurks everywhere, and even the most careful disinfection is not able to destroy the germs and stop the progress of disease if the stable and surroundings are in an unclean and unsanitary condition, besides being poorly lighted and ventilated.

Light and ventilation alone will to a great extent check the spread of tuberculosis among animals, by increasing vitality and power of resistance. In the erection of stables we certainly should not follow the advice of Reynolds (Minnesota), who thinks the value of ventilation is overestimated; "that when animals confined in unventilated stables are injuriously affected, it is so because of lack of exercise, lack of sunshine, and a concentration of

pathogenic microörganisms." The last assertion upsets his theory, because in stables with good ventilation there cannot be a concentration of microörganisms and tuberculosis cannot spread as rapidly.

Klimmer states that after introduction of good ventilation in stables the morbidity and mortality among animals decreases, while their productiveness increases. To this effect Damman reports that eighty well-fed Swiss cows in a stable, at Frankfort-on-the-Main, after installation of a good system of ventilation, on the same ration and quality of food averaged 483 quarts of milk more annually than before the installation.

That the stables will need plenty of light, although the cattle should be protected against the hot rays of the sun during the middle of the summer days, can easily be observed, for, according to Koch, the sunlight kills the tubercle bacilli in a few minutes, and the divergent daylight has the same effect, only the destruction occurs more slowly.

The floor ought to be so constructed that the gutters drain rapidly, and consist of material which can be easily cleansed and disinfected, because here we find the greatest danger.

Through their experiments Schroeder and Mohler, and Schroeder and Cotton were convinced that there is no other source from which the tubercle bacilli may be spread to a greater extent than from the milk mixed with the particles of fresh excrement of tubercular cows proved by tuberculin to be afflicted, but Reynolds could find the results only in the feces of one reacting milch-cow. These investigators contaminated fresh milk from healthy cows with feces coming from reacting cattle. Some of this milk was strained and injected; the rest was used hypodermically in its natural state. In both cases they were able to produce tuberculosis in guinea-pigs.

Is not this argument convincing enough that the stables should be properly disinfected every day, the cows and their udders thoroughly cleansed before milking, and the persons attending to the milking be healthy and should be careful not to contaminate their hands with fecal matter? The utmost cleanliness must be exercised during the act of milking, because the results caused by neglecting these rules may be more disastrous than commonly realized. The international Congress of Dairymen, held in Paris, October 16, 1905, in one of the resolutions adopted, recommends to institute a control over dairy farms similar to that exercised over meat markets.

The only precaution we have against this way of infection is pasteurization or sterilization of milk. As long as we have no knowledge of the condition of a stable as to sanitation and the existence of tuberculosis therein, it is the safest to use one or the other method as protection against acquiring the disease.

This mode of infection, by way of manure carried into the milk, is not to be underestimated, either for infants or for calves. But without a doubt

the greatest danger arises from the cow afflicted with tuberculosis of the udder, or with generalization of the disease, where germs are passed more or less with the milk. Nothing is done by most of the farmers in this direction to prevent the calves from contracting the disease from the dam until their attention is awakened when it is too late.

The farmer who operates a dairy farm and raises cattle for breeding purposes should be compelled by law to have his cattle undergo a physical examination at least twice a year, or once by the tuberculin test. Upon a thorough physical examination we will find only affected animals showing clinical symptoms, while with the aid of the tuberculin test most all of the diseased animals are discovered by the appearing reaction.

All animals with clinical symptoms should be removed as quickly as possible and destroyed, because their presence is a standing menace to the healthy ones. Those which respond to the tuberculin, showing a clear reaction, should be disposed of according to one or the other method in vogue. I shall mention here the Bang system, which is the most economical, and too well known to go into details, although not popular on the American continent; the Ostertag method, which only relies on the physical examination of animals, while it contends that the danger of animals which react to the tuberculin is very slight, as proved by Nocard, Bang, Schroeder and others, and by his own experiments, notwithstanding Rabinowitsch's and Mohler's findings to the contrary.

None of these scientists could find tubercle bacilli in the milk of such cows, or produce tuberculosis in guinea-pigs by injecting the same subcutaneously. The same results are reported by Kinnell, Massachusetts, from practical observation made on the herds of Sloane and Colt, 1894, published in his article, "Sanitation versus Tuberculin in the Eradication of Tuberculosis."* He noticed that none of the heifers which had been born and reared by reacting dams responded to the tuberculin. He ascribed this phenomenon to the rule at the Sloane farm, that young animals after weaning were kept separated in the stable from the part which was occupied by the cows. He had the same experience with calves on the Colt farm, where even the sanitary conditions were very bad.

Undoubtedly these contentions are correct. But there is one drawback to these methods—keeping the source of infection constantly on the premises. Where the infection is in reaching distance, it is hardly possible to keep the disease from the healthy animals. On the other hand, a compulsory tuberculin test, as it was practised in Massachusetts and Belgium, was soon shown to be too radical and expensive, and, therefore, not advisable.

In Pennsylvania, Pearson, the secretary of the State Live-stock Sanitary Board, advised the following measures, which were adopted: Wherever an

* Journal Comp. Med., 1898, No. 6.

owner desires to free his herd from tuberculosis and has the same tested at his own expense, he may ask for the aid of the State to dispose of the afflicted cattle, according to the rules and regulations of the meat hygiene service. Otherwise, where a demand is made for an immediate examination or a complaint is entered, a physical examination is made. If conditions of such herds and premises are very bad, a compulsory tuberculin test with thorough cleaning is ordered. The reacting cattle are quarantined and the owner notified to boil or pasteurize the milk before using.

The tuberculin test is mandatory in all cases where cattle are imported into Pennsylvania from any other State or country, by legislation approved May 26, 1897; an act to protect the health of domestic animals of the commonwealth of Pennsylvania and the regulations in conformity with this act governing the driving or shipping of dairy cows and neat cattle for breeding purposes into Pennsylvania on and after January 1, 1908.

If any of the shipped cattle react, they must be killed under the supervision of a veterinarian and disposed of according to the rules of the State meat hygiene service, because the dealer is prevented from reshipping the tubercular animals on account of an order recently issued by the secretary of the United States Department of Agriculture, prohibiting the shipping of tubercular cattle from one State into another.

Without a doubt tuberculin is the principal and only aid which will enable us to eradicate tuberculosis. We have already some herds in the State of Pennsylvania where this scourge is eliminated. To keep it out of the herd takes as much care and attention as it does to free the herd from this disease.

I shall give an instance where by the slightest neglect tuberculosis was reintroduced into a herd: at State College the dairy herd was found to be free from tuberculosis, no animal reacting, while four calves, ranging in age between three and six months, were found to be tubercular. Upon investigation it was apparent that the skimmed milk was the cause of the trouble. The milk of untested milch-cows was brought by the neighboring farmers to the creamery and mixed with their own in the separator. The skimmed milk afterward was warmed in tepid water and fed to the calves. Could any better condition be created for the growth of the bacilli? It was only astonishing that not many more were infected.

Thus we can see that tuberculin is the only medium by which we may eliminate tuberculosis from cattle, and is also recognized, even by laymen, as the only safe agent to detect and determine the condition as to the prevalence of disease in a dairy herd, which is evident from the resolutions passed by the International Congress of Dairymen, October, 1905, at Paris.

All cows intended for the production of milk for consumption should be provided with a certificate of health by a veterinarian, and each milk establishment should be the object of frequent sanitary visits.

Each tubercular milch-cow, even without any noticeable clinical symptoms, giving simply a clear and positive reaction to the tuberculin, should be eliminated from the milk industry, or milk coming from such milch-cows should only be consumed after having been previously heated long enough and at a temperature sufficiently high to render the tubercle bacilli inoffensive.

The milk should only be consumed in the raw state if the cows did not react to the tuberculin when the tuberculinization was made under the control of a competent man. All commercial by-products from milk coming from tubercular animals should be sterilized before they are given to the trade.*

Finally, one may consider under preventive measures, against the acquisition of tuberculosis, immunization. For this purpose vaccines are prepared from human tubercle bacilli, which, after being raised in cultures for many generations, have lost more or less of their virulence and are then injected into the jugular vein of young calves. At present two methods are still in use—von Behring's and Pearson's. What importance these modes of protection may have is still a matter of speculation; although I am satisfied that Pearson has better results than von Behring, because Pearson demands the removal of tubercular animals from the herd before vaccination and reduces the danger of infection to a minimum.

I think the best results will be obtained in the cheapest and easiest way by the farmer if he can be convinced and induced to boil the milk he feeds to the calves, and keep them separated from the other cattle.

In conclusion, I recapitulate that the transmission of tuberculosis from animal to animal may be prevented:

(A) By meat inspection:

1. By the proper destruction of tubercular material from diseased carcasses.
2. By cleanliness and sanitary conditions of slaughter-houses.
3. By the discovery of the sources of infection.

(B) By dairy herd inspection

1. Through proper ventilation, lighting, and disinfection of stables, which will materially aid in the destruction of tubercular germs; especially since, according to Schroeder and Mohler and Schroeder and Cotton, manure from tubercular cattle, even if they are only reacting to the tuberculin, contains more or less tubercle bacilli.
2. Examination of each animal should be made physically at least twice, or by tuberculin once during the year. The tubercular animals should be destroyed, for only in this way can the source of infection be removed.

* Revue Vetérinarire, 1905, p. 863.

Die Inspektion von Fleisch und Viehherden als Verhütungsmassregel gegen die Verbreitung der Tuberkulose unter dem Rindvieh.—(NOACK.)

Die Einheitlichkeit des Tuberkelbazillus ist heute überall anerkannt, und selbst wenn die preussische Regierung Koch's Theorie verwirft, lässt sie Forschungen über die Untersuchungsarbeiten von Damman und Müssemeier machen und nimmt an was jene gefunden haben. Auch die englische Kommission kommt im Jahre 1907 öfters darauf zurück: "Mensch und Tier können einander infizieren."

Alle Massnahmen, um den Menschen gegen die Übertragung der Tuberkulose von Tieren zu schützen, streben zur selben Zeit danach, die Ausbreitung vom Tier zu verhindern. Die hauptsächlichen Faktoren in dieser Richtung sind die Inspektionen des Fleisches und des Herdenviehs.

1. Fleischinspektion verursacht die richtige Vernichtung tuberkulösen Materials.

2. Die Regeln und Vorschriften eines solchen Dienstes und die Aufsicht über die Schlachthäuser erzwingen Reinlichkeit dieser Plätze, welche andernfalls Treibhäuser der Tuberkelbazillen wären.

3. Durch die Inspektion kann ein System zur Entdeckung der Quellen der Tuberkulose geschaffen werden. Pennsylvanien hat ein System dieser Art durch den "Butchers' Indemnity Act von 1903" ins Leben gerufen.

Das System führt uns zur Inspektion der Viehherden, welche ungefähr das Folgende bringt:

Erstens: Richtige Ventilation, Beleuchtung und Desinfection von Ställen, Massregeln, welche hauptsächlich in der Zerstörung tuberkulöser Keime mithelfen werden, und die absolut notwendig sind, seitdem Schroeder und Mohler und Schroeder und Cotton bewiesen, dass tuberkulöse Rinder, selbst wenn sie nur auf Tuberkulin reagieren, mehr oder weniger den Tuberkelbazillus in sich tragen.

Zweitens: Untersuchung eines jeden Tieres entweder physikalisch, was zum mindesten zweimal jährlich geschehen sollte, oder durch Tuberkulin. Das Schlachten der Befallenen bedeutet die Eliminirung einer ständigen Gefahr.

Pennsylvanien hat in dieser Richtung die besten Massnahmen, um erkranktes Vieh bei Seite zu schaffen.

Inspection des Bêtes de Baucherie et des Vaches laitières pour empêcher la Propagation de la Tuberculose chez le Bètail.—(NOACK.)

L'uniformité du bacille tuberculeux est aujourd'hui admise par tout le monde: le gouvernement prussien lui-même a réfuté la théorie de Koch en ordonnant les recherches de Damman et de Muessemeier et en acceptant

les résultats obtenus. La Commission anglaise, elle aussi, déclara en 1907: l'homme et la bête peuvent s'infecter réciproquement.

Toutes les mesures prises pour empêcher la contagion tuberculeuse de l'homme par l'animal ont aussi pour effet de diminuer les chances de contagion de l'animal par l'animal. Les principales sont l'inspection de la viande et l'inspection des vaches laitières.

1. L'inspection de la viande fait détruire comme il le faut des matières tuberculeuses.

2. Les arrêtés et les réglements du service d'inspection et la surveillance des abattoirs rendent la propreté et la sanitation obligatoires en des lieux qui, autrement, seraient des foyers de culture pour les bacilles tuberculeux.

3. L'inspection permet d'établir un système pour découvrir les sources de tuberculose. La Pensylvanie a un système de ce genre créé par la loi d'indemnité des bouchers (Butchers' Indemnity Act, 1903).

Ce système nous amène à l'inspection des vaches laitières, qui produit les rèsultats suivants:

1. La ventilation, l'éclairage et la désinfection convenables des étables, mesures qui aident beaucoup à détruire les germes tuberculeux. Ces mesures nécessaires, puisque Schroeder et Mohler et Schroeder et Cotton ont prouvé que le bétail tuberculeux, même le bétail qui ne fait que réagi à la tuberculine, contient plus ou moins le germe de la tuberculose.

2. L'examen de chaque animal, soit physique (lequel devrait se faire au moins deux fois par an), soit à la tuberculine. L'abattage des animaux affectés, c'est l'élimination d'un danger constant. L'État de Pensylvanie emploie les meilleurs moyens de disposer des animaux affectés.

VACCINATION GEGEN TUBERKULOSE BEIM RINDE.

Von Prof. J. F. Heymans,
Ghent, Belgien.

Es geschieht auf Veranlassung meines Freundes und Spezialkollegen, Hofrat Meyer, dass ich heute die Ehre habe, das Katheder Ihrer Gesellschaft zu besteigen, um Ihnen über Tuberkuloseimpfung zu berichten.

Die Impfungsverfahren von v. Behring, Koch, und Schutz, v. Baumgarten, Lignieres, Friedmann, Calmette, Vallee, Arloing u. a. sind Ihnen bekannt; ich kann also direkt zur Beschreibung meiner Methode, wozu jetzt schon ein bestimmter Mut gehört, übergehen, ohne dabei Kritik- oder Ueberlegenheitsfragen aufwirbeln zu wollen; das Richtige darüber werden mit der Zeit nüchternes Denken und die Erfahrungen von selbst herausschalen.

Wer von Impfung gegen Tuberkulose spricht, muss selbstredend die Möglichkeit einer erworbenen Immunität, eventuell Heilung bei Menschen und Tieren heilt, bzw. nicht immer tödlich wirkt, bestreitet wohl niemand; dass die "Superinfektion" bei weitem nicht dieselbe Tuberkelbildung hervorruft wie die Grundinfektion, kann täglich experimentell bewiesen werden. Dass ein gesundes, in einen verseuchten Stall gebrachtes Rindvieh, einmal infiziert, in demselben jahrelang derselben Infektion ausgesetzt, bei der Sektion nur die abgekapselten und verkalkten Tuberkelläsionen der ersten Infektion oder gar keine Läsionen zeigt, habe ich, wie andere, schon oft beobachtet; beim gesunden Rinde, resp. Menschen, genügen wenige, in den Respirations- oder Digestionsapparat gebrachte Bazillen, um die Entstehung von Tuberkeln hervorzurufen; dagegen kann eine mit offener Tuberkulose behaftete Lunge tagein, tagaus massenhaft Bazillen eliminieren, ohne dass neue Tuberkeln im gesunden Teile der Lunge, im Kehlkopfe, im Darmtraktus u. s. w. entstehen. Diese und viele andere Gründe beweisen unstreitbar, dass der unter dem Einflusse von Tuberkeln stehende Organismus gegen eine neue Tuberkelbildung deutlich widerstandsfähiger ist, dass also eine erhöhte Resistenz oder Immunität gegen eine neue Bazilleninfektion besteht und dass diese Reaktion des Organismus zur vollkommenen Abkapselung und Heilung der stattgehabten Infektion führen kann und führt.

Das Problem der Impfung gegen Tuberkulose, wie dasselbe für die Blattern schon gelöst ist, müsste also durch die Herstellung eines impfenden

Tuberkels, mit all den Vorteilen, aber ohne die Nachteile des spontanen Tuberkels, gelöst und dieses Problem wird gelöst sein, wenn wir den zu impfenden Organismus und den impfenden Tuberkelbazillus in solche Wechselwirkung bringen, dass keine progressive Tuberkuloseinfektion auftritt.

Um diesen reziproken Zustand herzustellen, haben wir folgendes Verfahren eingeschlagen. Wir füllen etwa 1 mg. lebender, mit Pulver verdünnter Bazillen—welche Qualität und Quantität von Bazillen die besseren Resultate geben, ist noch nicht entschieden—in ein Schilfrohrsäckchen, das zugebunden und der Sicherheit wegen darauf kollodioniert wird und dieses bazillenhältige Säckchen wird unter die Haut des Rindes gebracht. Statt längerer Beschreibung demonstriere ich Ihnen gleich die fertigen Säckchen, die zur Operation nötigen Instrumente, sowie das sehr einfache Operationsverfahren selbst.

Dass das unter die Haut gebrachte Säckchen vaccinierend wirken kann und wirkt, geht aus folgenden Daten hervor: Ich bringe 0.5 cm.^{3} Rohtuberkulin in ein Säckchen und lasse sie 24 Stunden gegen 5.0 cm.^{3} physiologischer Kochsalzlösung diffundieren, spritze dann diese 5.0 cm.^{3} einem tuberkulösen Rinde ein; letzteres reagiert typisch. Tuberkulin diffundiert also durch die intakte Membran des Säckchens, wie Sie aus der Farbe des herumgereichten Rohres schon erschliessen können.

In ein 0.5 cm.^{3} Glyzerinbouillon enthaltendes Säckchen impfe ich Tuberkelbazillen über und bringe dann das Säckchen in einen, 50 cm.^{3} Glyzerinbouillon enthaltenden Kolben; die Bazillen entwickeln sich im Brutofen allmählich zu einer kompakten, zylindrischen Säule, welche bis unten und bis oben das Lumen des Säckchens erfüllt, wie die drei hier mitgebrachten Kolben deutlich zeigen. Es lässt sich nun zeigen, dass die Bouillon, in welcher das Säckchen hängt, dieselben spezifischen Eigenschaften besitzt, wie diejenige, auf deren Oberfläche sich eine dicke Haut von Tuberkelbazillen frei entwickelt, d. h. sie ist tuberkulinhältig und die Bazillen vermehren sich, als ob sie die ganze Bouillon des Kolbens zur Ernährung und Sekretion frei zur Verfügung hätten.

Wie in vitro und im Brutofen, verhält sich das unter die Haut des Rindes gebrachte Säckchen. Ein tuberkulöses Rind reagiert typisch, wenn man unter die Haut ein 0.5 cm.^{3} Rohtuberkulin enthaltendes Säckchen bringt. Anderseits, wenn ein Bazillen enthaltendes Säckchen unter die Haut gelegt wird, gedeihen die in ihm befindlichen Bazillen, wie mikroskopische Schnitte dieses Säckchens zeigen, und zwar so lange, als sie per Diffusion die nötigen Nährstoffe erhalten. Wie Infektionen bei Meerschweinchen zeigen, bleiben die Bazillen am Leben und sezernieren im Organismus des geimpften Tieres ihre spezifischen Stoffe, so lange die herein diffundierten Substanzen nicht völlig bakterizid gewirkt haben, d. h. so lange keine genügende Immunität des Organismus besteht.

Rund um ein unter die Haut gebrachtes Säckchen bildet sich schon in den ersten 48 Stunden ein fast nur aus polynukleären Zellen zusammengesetztes Exsudat, um das sich innerhalb vier bis acht Tagen eine derbe Bindegewebskapsel entwickelt. Im Zentrum befindet sich das intakte Säckchen, welches keine Zellen enthält, wohl aber Bazillen, die ausserhalb des Säckchens mikroskopisch nicht zu finden sind. Der kleine Impfknoten gleicht alsdann vollkommen einem Tuberkel, mit Ausnahme der totalen Trennung und Isolierung der Bazillen. Nach sechs bis acht Monaten verkalkt und zu gleicher Zeit atrophiert der Impfknoten in toto, die Bazillen zerfallen, degenerieren und sterben ab, so dass der ganze Inhalt eines Impftuberkels nach 12 bis 18 Monaten, einem Meerschweinchen eingespritzt, keine Tuberkulose hervorruft.

Dass ein hermetisch verschlossenes Säckchen als Diffusionsmembran nur die spezifischen Bazillenprodukte wirkt und anderseits das Heraustreten der in ihm enthaltenen Bazillen verhindert, unter anderem, dass das Säckchen nicht platzt, ist leicht zu demonstrieren. Bei Rindern, welche eine bis vier Wochen nach der Impfung geschlachtet werden, kann man das Säckchen aus dem Impfknoten absolut intakt herausholen, wie die vier hier mitgebrachten Exemplare beweisen und die Emulsion der das Säckchen umgebenden Schicht infiziert Meerschweinchen nicht. Das weitere Schicksal des Säckchens als Dialysator hängt im allgemeinen von der Qualität und Quantität der Bazillen, besonders von dem Digestions- und Immunisierungsvermögen des geimpften Organismus ab; über die Einzelheiten dieser Vorgänge bin ich noch nicht genügend orientiert.

Wie das eingeimpfte und in einem Kolben aufgehängte Säckchen die umgebende Bouillon mit spezifischen Bazillenprodukten bereichert, so imprägnieren auch die in ihm enthaltenen Bazillen den Körper des geimpften Tieres mit denselben spezifischen Stoffen: ein nicht tuberkulöses Rind reagiert nämlich drei bis sechs Wochen nach der Impfung charakteristisch auf Tuberkulin—wie Moussu auf ähnliche Weise mit Tonerdefilter beobachtet hat—ganz wie ein tuberkulöses Tier, u. zw. deshalb, weil die Allgemeinwirkung des Impftuberkels dieselbe ist wie die des Infektionstuberkels.

Diese Tuberkulen-Überempfindlichkeit verschwindet durchschnittlich sechs bis acht Monate nach der Impfung, so dass gesund geimpfte Rinder, welche acht bis zwölf Monate später auf Tuberkulin nicht reagieren, als tuberkulosefrei betrachtet werden können.

Was bei dem Auftreten, Bestehen und Verschwinden der Tuberkulin-Überempfindlichkeit, resp. bei der Immunisierung des geimpften Tieres sich im Organismus ändert, ist eine Frage, deren Lösung die Erkenntnis des Mechanismus der Impfung fordern wird, welche uns aber erst interessieren wird, wenn wir über das Bestehen einer antituberkulosen Vaccination einig sind.

Ist also ein säckchentragendes Rind gegen eine experimentelle, bzw. gegen eine spontane Infektion geimpft? Wenn wir oben eine bestimmte Immunität und Heilung bei der spontanen Tuberkulose als bewiesen annehmen, so brauchen wir hier wohl kaum hinzuzufügen, dass dieselbe, was Intensität und Dauer betrifft, nur eine relative ist. Dass die mittels der Säckchenmethode geimpften Rinder weniger schnell und weniger hochgradig subkutan oder per os infizierbar als die Kontrolltiere, geht aus drei Versuchsreihen von insgesamt 36 Rindern hervor. Kurz zusammengefasst, sind die Hauptresultate folgende: Kontrolltiere erliegen der Infektion, geimpfte nicht; letztere reagieren später auf Tuberkulin und zeigen bei der Schlachtung weniger ausgedehnte Läsionen als erstere.

Dass diese der experimentellen Infektion gegenüber erhöhte Resistenz der geimpften Tiere genügt, um dieselbe gegen die natürliche Infektion greifbar zu schützen, beweisen die Beobachtungen von verschiedenen, in der Praxis daraufhin angestellten Versuchsreihen: Zehn nicht reagierende Rinder, davon fünf geimpfte, werden direkt in einen verseuchten Stall gebracht; fünf Monate später geschlachtet, sind von den fünf geimpften eines tuberkulös, vier nicht; von den fünf nicht geimpften sind vier tuberkulös, eines nicht. Von 18 anderen gesunden Rindern, davon neun geimpft, wurden unter den Kontrolltieren sechs tuberkulös, drei nicht und von den neun geimpften zwei tuberkulös, eines zweifelhaft und sechs nicht tuberkulös bei der Schlachtung gefunden.

Von den über 4000 gesunden, in den Jahren 1905, 1906 und 1907 geimpften Rindern haben die Retuberkulinisationen ergeben, dass die Mehrzahl derselben (ca. 80%) nicht reagierten, dass sie also tuberkulosefrei geblieben sind, wenn wir uns auf die Tuberkulinreaktion bei geimpften Tieren verlassen können. Die genaue Obduktion dieser Tiere allein kann darüber entscheiden; unter den ca. 500 bis jetzt obduzierten Rindern sind etwa 150 gesund geimpfte Tiere, welche bei der Retuberkulinisation nicht reagierten; tuberkulöse Läsionen wurden bei etwa sechs Stück gefunden. Wenn also die Tuberkulineinspritzung nur etwa ein Jahr nach der Impfung gemacht wird, ist dieselbe für die Diagnose ebenso beweisend bei geimpften wie bei nicht geimpften Rindern.

Aus den Ergebnissen dieser zahlreichen Versuche und Beobachtungen glaube ich schliessen zu können, dass die mittels der Säckchenmethode geimpften Tiere bedeutend resistenter sind gegen die künstliche, sowie die spontane Infektion.

In der Praxis würden in allen Viehbeständen nicht nur die nicht reagierenden, sondern auch die schon reagierenden Rinder geimpft; da bei den letzteren wie bei den ersteren die im Säckchen eingeschlossenen Bazillen ebenfalls langsam, aber kontinuierlich Tuberkulinstoffe im tuberkulösen Organismus hereindiffundieren lassen, ohne je die geringste allgemeine Reaktion hervor-

zurufen, so stellt die Säckchenmethode wohl die idealste Einspritzungsmethode von Tuberkulin als kuratives Mittel bei der Tuberkulose dar. Bei der Bekämpfung der Rindertuberkulose ist die eventuelle Heilung oder Besserung tuberkulöser Tiere selbst Nebensache, aber sie vermindert die Infektiosität unter dem Viehbestande. Soviel kann ich bis jetzt behaupten, dass die geimpften tuberkulösen Rinder in grösserer Zahl als die nicht geimpften aufhören, auf Tuberkulin zu reagieren und dass sie bei der Obduktion bedeutende regressive Läsionen zeigen.

Wie die schon publizierten Resultate ergeben haben kann man mit der Impfung allein die Infektion der gesunden Rinder in den verseuchten Viehbeständen eindämmen; zu einer rationellen und praktischen Bekämpfung der Verseuchung muss man selbstredend so weit wie möglich alle prophylaktischen Massregeln, wie Isolierung, Schlachten der Tiere mit offener Tuberkulose, Sterilisieren der Milch u. s. w. mitwirken lassen.

Zur Eruierung der Dauer der Immunität sind in einer Reihe von Viehbeständen die Impfungen etwa halbjährlich wiederholt worden, in den meisten aber nur jährlich, wobei jedesmal die neu hinzugekommenen Tiere erst geimpft wurden: Versuche über je zweijährige Impfung oder länger sind noch nicht abgeschlossen; soviel scheint festzustehen, dass eine jährliche Impfung des Viehbestandes mehr wie genügt.

THE VACCINATION OF CATTLE AGAINST TUBERCULOSIS.

Abstract of Paper by Leonard Pearson, V.M.D.,
State Veterinarian, Philadelphia, Pa.

It is now established that the resistance of cattle to infection by the tubercle bacillus may be increased by vaccination with living tubercle bacilli of the types that produce natural infection in mammals. It is necessary that the culture used for vaccinating shall be of such low virulence as to be non-pathogenic for the species of animal upon which it is used. It does not seem to be proved that tubercle bacilli from birds will produce immunity in mammals, nor has it been possible to produce a material or serviceable degree of immunity by the use of dead tubercle bacilli or extracts.

The best results, thus far, have come from the use upon cattle of cultures of human origin and type. The vitality of the vaccine is important. Any drying or grinding process that kills a part of the tubercle bacilli, or weakens them, lessens the efficiency of the vaccine.

The degree of immunity is proportional, in large measure, to the extent of vaccination—*i. e.*, to the number of times vaccinated, the dosage, and the period of time recovered. The duration of resistance is from one to three years.

Vaccine may be administered subcutaneously or intravenously. To give to cattle by the mouth cultures of tubercle bacilli that are virulent for man, or for any domestic animal, as swine, is not to be recommended in practice.

The method of administering a vaccine in a capsule inserted beneath the skin, as proposed by Heymans and extensively used by him in Belgium, appears to be promising, and should be tried in comparison with other methods.

To restore immunity after it has disappeared, in milking cows, one should not use a vaccine that is virulent for man, unless it shall be established, beyond doubt, that there is no possibility that any of the bacilli so introduced are excreted through the udder. But it appears that an avirulent culture may be used for this purpose. Klimmer's work with such a culture is most valuable.

A disadvantage of vaccination by the intravenous method is that it is followed by a short negative phase or period during which resistance to

infection is diminished. Hence, it is necessary that cattle so vaccinated shall be carefully protected from exposure during the whole period that they are undergoing vaccination, and for at least six weeks thereafter. Another disadvantage is that for as much as six months after vaccination, and sometimes longer, there is a hypersensitiveness to tuberculin, so that one is not in position, by the use of the tuberculin test, to determine whether the animal is or is not infected with tuberculosis.

By the combined use of a modification of the Bang system and vaccination, it should be possible to control tuberculosis in herds where the Bang system in its entirety is not practicable.

DISCUSSION.

Prof. Heymans: My method of immunization against tuberculosis is based upon the production of an artificial tubercle, but this tubercle has not the power of infection.

A fundamental experiment to prove the value of my vaccination is by taking a flask, filling the same to a certain height with a glycerin bouillon medium, and then placing in the same a sac of living tubercle bacilli. After a certain time it will be found that the bacilli will grow and produce colonies in the sacs, while the bouillon will contain the toxins of the tubercle bacilli—the tuberculin.

This can also be proved by inoculations into animals, which will show a reaction to the tuberculin test if they should be affected with tuberculosis. These experiments can be repeated every day, and will demonstrate clearly the method of immunization carried out by me.

In practice the same method may be applied by introducing into the animal a sac with raw tuberculin; such an animal will soon react to the tuberculin test, showing that the tuberculin transfuses into the organism. On the other hand, if I introduce tubercle bacilli into the sac, and the sac into the body, they draw through the membrane of the sac from the body the substance required for their sustenance. The bacilli remain in the sacs, but their toxins pass outside and saturate the body without producing an infection. The sacs may be taken out, and it will be seen that they contain the living organisms and are otherwise intact. If such a sac is removed from the body, it is found that two days after its introduction it is covered with an exudate which forms around the sac. In eight days the sac becomes almost entirely encapsulated by connective tissue; thereby an artificial tubercle is produced, from which no bacilli can escape. Yet by dialysis the toxins leave constantly from the sac, thus saturating the organism, while in the natural tubercle the bacilli can and do, of course, leave the tubercle together with the toxins.

The numerous experiments which I have carried out on animals proved the practicability of this method.

In the experiments, the animals which were vaccinated showed resistance, while of the control animals not a single one escaped the disease.

The lesions in the vaccinated animal are always confined to small areas. They are calcified and show a retrogressive form of the disease. The vaccination is performed in the following manner:

A stable is entered, and all animals in the herd are tuberculin-tested. After the tuberculin test all the animals of the herd are vaccinated. There are numerous places where we have employed this method for the last four years, the tuberculinization with the vaccination, and it has given entirely satisfactory results. At 6 o'clock in the evening the animals are tuberculinized and temperatures are taken. Next morning at 6, 9, and 12 the temperatures are taken, and between 9 and 12 the vaccination is accomplished; no time is therefore wasted.

In an infected stable 10 animals were taken which were vaccinated, and 10 control animals were used. Of these controls, 8 developed tuberculosis, while only 2 of the vaccinated animals became infected. This goes to show that if a vaccinated animal is brought into an infected stable it will have more resistance against the disease; and if the disease is contracted, it will not be as severe as under ordinary circumstances.

In Belgium up to this date one thousand herds have been vaccinated, with about 40,000 animals. All animals are vaccinated, whether tuberculous, pregnant, or those which have just given birth. There are absolutely no ill effects noticed from the vaccination, except occasionally the formation of a localized abscess is noticed, which is the result of a mixed infection at the place of inoculation. However, they heal readily. The vaccination takes one minute. The record shows that in 20 herds in one day 400 animals were vaccinated, showing the simplicity of the technic of the vaccination. The immunity is only a relative one and the duration of the immunity is not yet established, but it can be positively stated to last one year. This may be proved, since the bacilli in the sac are still alive after ten to twelve months, which was established by test inoculations on guinea-pigs, and therefore the immunity will last at least during the time living tubercle bacilli are present. After this time the bacilli die and the dead bacilli in the sac calcify.

The following results have been obtained by this method of vaccination. If in a herd of 100 tubercular animals 40 prove tuberculous the first year, there is a gradual decrease in the percentage from year to year, which in the course of three years has been reduced to 20, and in some of the herds to 12 per cent. Of course, it is necessary at the same time to carry out the prophylactic and hygienic measures in order to prevent the introduction of the disease into the very young stock before vaccination could have taken

place, and therefore all animals affected with tuberculosis of the udder, and with open tuberculosis, should be destroyed, and the recommendations made by Professor Bang, in connection with prophylaxis should be carefully executed. It is desirable to raise such animals as will resist infection. Not only do I vaccinate non-reacting animals, but also those that react, believing that the vaccination is not only preventive but also curative. There is constantly a small quantity of tuberculin given out from these sacs into the body, which seems to be the ideal method for treatment now so extensively advocated in human practice. That there is a curative action obtained by vaccination is also proved by the fact that frequently animals which were vaccinated will fail to react the second time when tuberculinized. An autopsy is, of course, the most important test in order to see the results of vaccination, and in these tests I have found that a large number of animals which had been vaccinated either showed no lesions or only such as showed a retrogressive form of the disease.

If by this method a relative immunity can be established, a step farther will have been reached toward the eradication of tuberculosis in animals, and perhaps, in the future, also in human beings.

Prof. Bang: I have nothing to say about the vaccination of cattle, because I have done nothing along that line, but I am sure it is very interesting, and I am very glad to have had the opportunity of seeing the farm where Dr. Pearson made his experiments. I heartily congratulate him on the progress he has made, and I hope the next time we come together his method will be sufficient to produce immunity in animals, and also produce an immunity which will last forever. I shall be very glad if it can be done in a practical way.

Dr. Ryder (Chicago): I would like to ask if Professor Heymans uses the bovine type of bacilli in the capsule.

Prof. Heymans: I have used both the bovine and human types, but I feel that the use of bovine cultures is better. However, I have not carried out my experiments sufficiently far to express a definite opinion on that point.

Dr. Morris: I feel that this is one of the most vital subjects that has been presented to this Section. It seems to get at the root of the trouble. If some one can produce an immunity, that ends the disease. It would make any further investigations as to the transmission and as to the use of tuberculin unneccessary. I believe that if greater energy were put forth in this way, greater accomplishment would be obtained.

With reference to our experiments with bovo-vaccinations, I gave the animals the same attention that they would have under the ordinary conditions of farm life. We started with perfectly healthy calves and under sanitary conditions. I vaccinated them according to von Behring's method,

and at the end of two and a half years, when they were slaughtered, 5 out of the 12 calves had tuberculosis, and 7 of the control animals also had tuberculosis. There had been tuberculous cows placed in the herd six months after the infection of the last animals, thus giving them time to gain immunity.

Dr. Reichel (Pennsylvania): When does the animal commence to react after vaccination, and how long will it continue to react?

Prof. Heymans: The animal begins to react 4 weeks after vaccination and will cease to show sensitiveness for the tuberculin six to eight months after injection.

Dr. Connaway: In his procedure Dr. Pearson recommends the inoculation of the animals while they are young, and says that the immunity will continue for two or two and one half years. He also recommends that you do not inoculate animals during the milking period. This seems to be an important period to have animals immunized. What procedure would you recommend after the animal has come into the milk period?

Dr. Pearson: We do not recommend such vaccination with cultures that are virulent for man. If the culture employed is not virulent for man, the vaccination could be performed during the milk period, but the question is how to tell whether or not the culture is virulent for man.

I would like to ask Professor Bang how von Behring's method is accepted in Europe.

Professor Bang: I am sorry to say that I do not know much about it. I do not think it has been accepted generally, as the immunity produced does not extend more than one year.

I wish to express my sincere thanks to this Section in behalf of the farmers and dairymen of Denmark, and to congratulate you upon the army of veterinarians in America who are doing great work, and especially the honored President of this Section, whose work is highly appreciated not only by the veterinarians of America, but also by those of foreign countries.

I hope to have the pleasure of meeting many of the members of this Section again at the International Veterinary Congress, to be held next year at The Hague.

Dr. Pearson: I wish to thank Professor Bang for his kind expression in behalf of the people of Denmark. I am sure we have felt honored by his presence at these meetings, and I trust he will convey the greetings of the profession of this country to our honored confrères across the waters.

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